

WHAT'S COMING NEXT FROM INTEL

MARCH 1999

# Electronics NOW®

You can tune in the world  
when you build this

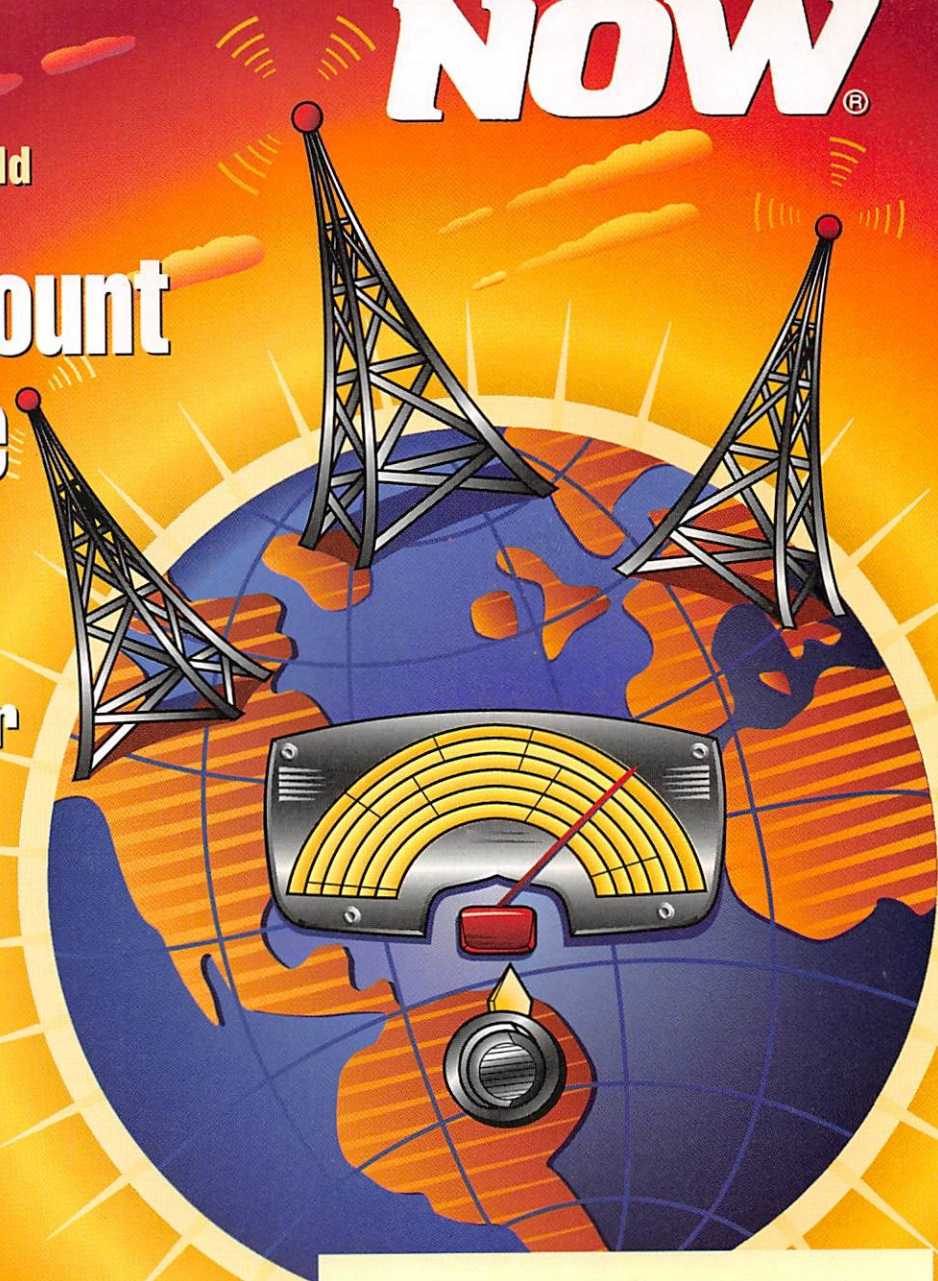
## Surface-Mount Shortwave Radio

### A Brain/Computer Interface

Helping the paralyzed  
to interact with the  
world around them

Unleash the  
power of the  
**SmartProbe**  
to test digital  
circuits and more

Measuring  
**RF Power**  
The right way to get  
accurate results



\$4.99 U.S.  
\$5.99 CAN.



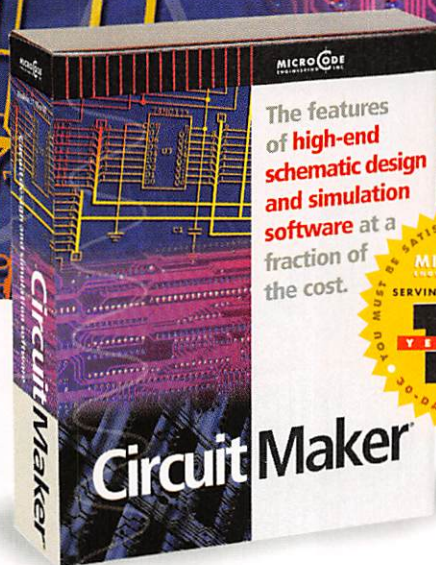
A GERNSBACK  
PUBLICATION



# High-end features. Low-end price.

**\$299**

**CircuitMaker 6:**  
Schematic design  
and simulation  
software



**\$299**

**TraxMaker 3:**  
Printed circuit  
board layout  
software

*CircuitMaker Version 6 and TraxMaker Version 3 give you the features of professional, high-end software at a fraction of the cost. Plus, with exceptional ease-of-use you'll spend less time learning to use the software and more time designing. Both applications are compatible with your existing software, and feature outstanding technical support. **Call now for your free functional demo.***

**CircuitMaker 6 is a powerful schematic design and simulation program featuring:**

- Professional schematic features including printout borders, title block and barred pin names
- Symbol editor and Macro feature for custom devices
- Fast, accurate SPICE3f5/XSPICE-based simulation
- Complete array of analysis types, including Fourier, AC, DC, Parameter sweep, Transient and more
- Virtual instruments including a digital oscilloscope, multimeter, Bode plotter, curve tracer and more
- Extensive library of over 4,000 models
- Tight integration with TraxMaker® for quick PCB layout
- Output PCB netlists in Protel®, Tango® and TraxMaker® formats for use in a variety of PCB layout programs
- Windows 3.1, 95 and NT

**TraxMaker 3 is a powerful printed circuit board layout program featuring:**

- Over 2,000 component footprints in a fully-documented, indexed library. Documentation shows footprints actual size
- Built-in autorouter and Design Rules Check
- Supports up to 6 signal layers plus power and ground planes, silk screen overlays and solder and paste masks
- Board sizes up to 32" x 32", with no pin limitations
- Intelligent manual routing with unroute capabilities
- Import any PCB netlist in CircuitMaker®, Protel® or Tango® format
- Output RS274X Gerber files, Excellon N/C drill files and Bill of Materials
- Print to any Windows-compatible printer or plotter
- Windows 3.1, 95 and NT

**MICROCODE**  
ENGINEERING INC

**For free demo software, or to order, call 1-800-419-4242**

927 West Center Street • Orem, UT 84057 • Phone (801) 226-4470 • Fax (801) 226-6532 • [www.microcode.com](http://www.microcode.com)

©1998 MicroCode Engineering, Inc. All rights reserved. CircuitMaker, TraxMaker, SimCode and MicroCode are registered trademarks of MicroCode Engineering, Inc. All other brand and product names are trademarks or registered trademarks of their respective companies.  
CIRCLE 133 ON FREE INFORMATION CARD



# CONTENTS

MARCH 1999

## ON THE COVER

### 33 SURFACE-MOUNT SHORTWAVE RADIO

Every once in a while we come up with a project that has something to offer almost everyone. This month's cover story is just such a project. The key is its unique circuit board—it is designed so that either traditional through-hole components OR surface-mount devices (SMDs) can be used at almost every location. The result is a project that's an effective yet inexpensive way to listen in on shortwave broadcasts, and/or is a valuable teaching tool to help you master the techniques required to build circuits using SMDs. Either way, it's a winner.

— Paul Yost



## DEPARTMENTS

### 7 EQUIPMENT REPORT

Matrix Multimedia interactive Digital Electronics CD-ROM.

### 8 SERVICE CLINIC

Monitor deflection circuits. — Sam Goldwasser

### 13 COMPUTER CONNECTIONS

What's coming next from Intel. — Konstantinos Karagiannis

### 57 TECH MUSINGS

AC and DC lamp-dimmer circuits, a surplus update, and more.  
— Don Lancaster

## AND MORE

### 2 EDITORIAL

### 3 Q&A

### 16 NEW PRODUCTS

### 22 NEW LITERATURE

### 30 LETTERS

### 100 ADVERTISING INDEX

### 100 ADVERTISING SALES OFFICE

## BUILD THIS

### 45 TEST DIGITAL CIRCUITS WITH THE SMARTPROBE

A significant improvement over the typical "dumb" logic probe, it can resolve four voltage levels, store the last 20 readings, and show the frequency and pulse width of signals on an oscilloscope-like display.

— James J. Barbarello

## TECHNOLOGY

### 25 PROTOTYPE

Crash-data recorders for your car, a virtual microscope, tiny chips, a healthy video monitor, and more.

### 51 MEASURING RF POWER

RF power is one of the most difficult parameters to measure correctly; here's how to do it. — Joseph J. Carr

### 55 A BRAIN/COMPUTER INTERFACE

A medical breakthrough that could one day allow paralyzed individuals to effectively communicate with those around them.

— Bill Siuru

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 1067-9294) March 1999. Published monthly by Gernsback Publications, Inc., 500 B-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$24.99, Canada \$33.15 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$33.99. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$4.99. © 1999 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.



Hugo Gernsback (1884-1967) founder

**LARRY STECKLER**, EHF, CET,  
Editor-in-chief and publisher

**ADRIA COREN**, Vice President

**KEN COREN**, Vice President

## EDITORIAL DEPARTMENT

**CARL LARON**, editor

**JOSEPH J. SUDA**, technical editor

**EVELYN ROSE**, assistant editor

**MICHAEL A. COVINGTON**, N4TMI  
contributing editor

**SAM GOLDWASSER**, service editor

**KONSTANTINOS KARAGIANNIS**,  
computer editor

**FRANKLIN J. MILLER**, audio editor

**DON LANCASTER**, contributing editor

**JANINE ABITABILE**, editorial assistant

## ART DEPARTMENT

**ANDRE DUZANT**, art director

**RUSSELL C. TRUELSON**, illustrator

## PRODUCTION DEPARTMENT

**RUBY M. YEE**, production director

**KATHRYN R. CAMPBELL**  
production assistant

**KEN COREN**

director of desktop production

## CIRCULATION DEPARTMENT

**THERESA LOMBARDO**

circulation director

**GINA GALLO**

circulation assistant

## REPRINT DEPARTMENT

**CHRISTINA M. ESTRADA**

reprint bookstore

Typography by Mates Graphics

**Electronics Now** is indexed in *Applied Science & Technology Index*, *and Readers Guide to Periodical Literature*, *Academic Abstracts*, and *Magazine Article Summaries*. Microfilm & Microfiche editions are available. Contact reprint bookstore for details.

## Advertising Sales Offices listed on page 100.

Electronics Now Executive and  
Administrative Offices  
**1-516-293-3000.**

Subscriber Customer Service:  
**1-800-288-0652.**

Order Entry for New Subscribers:  
**1-800-999-7139.**

VISIT US ON THE INTERNET AT  
**www.gernsback.com**

# EDITORIAL

## Changes

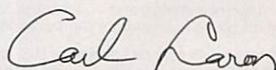
As everyone knows, nothing ever stays the same. Change is something we all must deal with, and how well we deal with it often determines how well we succeed in our careers—and our lives. Fortunately, most of the time, changes turn out for the best. Other times . . . well, let's just say that whatever does not kill you makes you stronger.

Anyway, as you might have guessed from the preceding, changes are afoot here at **Electronics Now**. The good news is that they all fall into the first category. In fact, one of those changes has already arrived.

Regular readers of our "Computer Connections" column might have noticed a new though perhaps familiar name on the byline. Jeff Holtzman, our long-time computer editor, has left to pursue other interests. In his place is Konstantinos Karagiannis. Konstantinos is the editor of our sister magazine, **Popular Electronics**. He's also served as the technical editor for *PC Upgrade*, *Computer Buyer's Guide and Handbook*, and *Laptop Buyer's Guide and Handbook* magazines. With his excellent contacts within the PC industry, Konstantinos is in a unique position to bring our readers the lowdown on what's happening today in computer hardware, and what to look forward to tomorrow. You'll also see expanded coverage within the column on practical hints and tips to get the most out of your current hardware, how to do repairs and upgrades, and what to look for when shopping for a first or replacement computer.

We also will be adding a couple of new columns in the coming months. While I can't reveal the details at present, I can tell you that they focus on some of the most popular aspects of the electronics hobby. We know you will enjoy them.

However, no matter how much things change, there is one thing I can promise will stay the same. That is our commitment to providing our readers with the best, most comprehensive coverage of the entire gamut that is electronics. We think the changes will help us to better fulfill that commitment, and we think you'll agree.



Carl Laron  
Editor



# Q & A

CONDUCTED BY MICHAEL A. COVINGTON, N4TM1

## Audio Induction Coil

**Q** I am 90 years old and have been reading *Gernsback electronics magazines* for many years. I once learned from your magazine how to hook up a Morse code key to a Model T spark coil to make a radio transmitter. It worked then, but today it would mess up a lot of people's TV reception.

My problem now is different. I need a schematic for a device to take the signal from a telephone circuit, amplify it, and feed it into a loop around a room. This should set up a magnetic field that can be detected by hearing aids with T coils. I know it has been done before. If you can be of any help on this, I and many of my senior friends would appreciate it.—H. B. A., Bay Village, OH

**A** What you describe is called audio induction. A large coil around the room and a small coil on the pickup unit form a big transformer, transferring the audio signal from one to the other magnetically. This isn't radio; little or no electromagnetic radiation is produced. (The coil is a monstrously inefficient antenna at audio frequencies.) Instead, what you're doing is exactly what goes on in transformers.

Some hearing aids use induction coils to pick up the signal from telephone receivers—it's more reliable than picking up the sound. Not having one of these hearing aids handy, we're not sure how sensitive they are, but Fig. 1 shows an audio induction circuit we've experimented with. The big coil has a resis-

tance of about 16 ohms and is fed with a few watts of audio, just as if it were a speaker. The small coil picks up a tiny audio-frequency signal, which is stepped up by the matching transformer and then fed to the microphone input of an amplifier. Pickup coils with substantially more turns may not need the transformer.

We trust you can adapt this circuit to your needs; you'll be using a hearing aid with an induction pickup in place of the pickup coil and amplifier. Others will find it useful as a way to transmit audio without wires to listeners who are free to move around and may even be on the other side of a wall.

## Remote Control Repeater

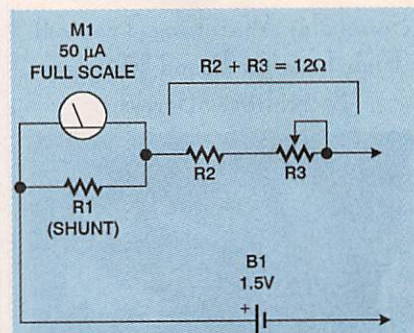
**Q** I'm sitting in my living room in my favorite chair trying to find the right angle at which to bounce the infrared remote control signal off the hall mirror and change the CD. What I need is a remote control extender. I tried to use the RadioShack IR receiver to modulate an IR emitter but I had no luck. What am I doing wrong?—T. P., St. Albert, Alberta, Canada

**A** The solution to the mystery is that the IR signal is chopped (turned on and off) at about 40 kHz to distinguish it from ambient IR light. The receiver module supplies un-chopped output, so you have to chop it again if you want to use it to control an IR-emitting LED. We published a circuit that does this in

the December, 1995 installment of this column.

## Sick Ohmmeter

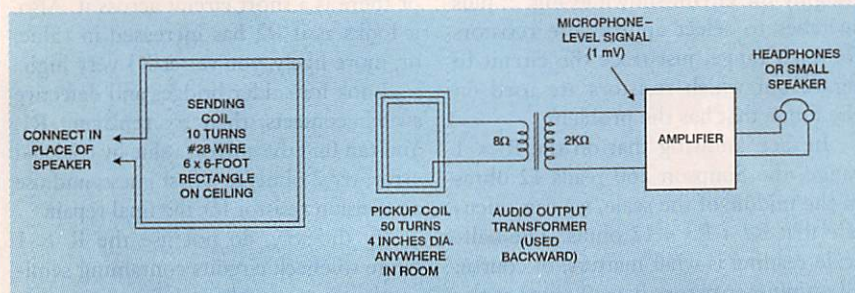
**Q** I recently dusted off my Simpson 260-5 (circa 1965) volt-ohm-milliammeter (VOM) and I'm having some trouble with the  $R \times 1$  scale readings. Fresh batteries and clean battery connections allow a full-scale 0 reading when I short the test leads, but the readings seem to be high by a factor of 4: 50-ohm resistors read 200 ohms, and so forth. I verified the test resistors with a DMM, VTVM, and another VOM. They all concur—the Simpson is off. The  $R \times 100$  and  $R \times 10K$  scales read normally, as do all voltage and current scales.



**FIG. 2**—THIS IS THE BASIC CIRCUIT of an ohmmeter that reads 12 ohms at half scale. The value of  $R1$  is determined by the resistance of  $M1$ , the meter movement.

If anyone recognizes this anomaly, or has service experience with the 260, I would greatly appreciate any suggestions. It's a great meter that's worth saving. Also, I'd like to get a schematic and owner's manual for it; any ideas on where or how? Thanks.—J.A., Stony Point, NY

**A** Your second question is easy: Simpson Electric Company is still in business and still making the 260, although they're now up to model 260-8 instead of 260-5. You can reach them at 8853 Dundee Ave., Elgin, IL 60120, Tel: 847-



**FIG. 1**—AN INDUCTION LOOP transmits audio a few feet without wires. Experiment with different pickup coils; some might not need a transformer.



## Accredited B.S. Degree in Computers or Electronics

by studying at Home

**Grantham College of Engineering**  
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
  - B.S.E.T. emphasis in Computers
  - B.S. in Computer Science
- NEW!** Electronics Workbench Professional 5.0 included in our B.S.E.T. curriculums  
-Approved by more than 200 Companies, VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial

**1-800-955-2527**

**<http://www.grantham.edu>**

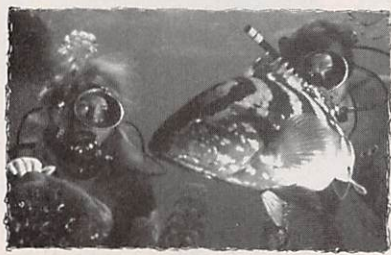
# GCE

Your first step  
to help yourself  
better your future!



**Grantham College of Engineering**  
34641 Grantham College Road  
Slidell, LA 70460-6815

Some Say Watching Tropical  
Fish Lowers Blood Pressure  
& Relieves Stress...



They Could Be On To  
Something.



Discover the Caribbean aboard a Tall Ship.  
6 & 13 day adventures from \$650.  
For more information call your travel agent  
or 1-800-327-2601.



**Windjammer  
Barefoot Cruises**

P.O. Box 190120, Dept. 5569 Miami Beach, FL 33119

## HOW TO GET INFORMATION ABOUT ELECTRONICS

**On the Internet:** See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups [sci.electronics.repair](mailto:sci.electronics.repair), [sci.electronics.components](mailto:sci.electronics.components), [sci.electronics.design](mailto:sci.electronics.design), and [rec.radio.amateur.homebrew](mailto:rec.radio.amateur.homebrew). "For sale" messages are permitted only in [rec.radio.swap](mailto:rec.radio.swap) and [misc.industry.electronics.marketplace](mailto:misc.industry.electronics.marketplace).

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. Extensive information about how to repair consumer electronic devices and computers can be found at [www.repairfaq.org](http://www.repairfaq.org)

**Books:** Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising over 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

**Copies of past articles:** Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1994 only) are available from our Claggg, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

697-2260, Web: [www.simpsonselecric.com](http://www.simpsonselecric.com). Many technicians prefer a traditional VOM because it can't be damaged by static electricity.

We don't have the schematic ourselves, nor is it necessary; the ohmmeter portion of a classic VOM always has roughly the circuit shown in Fig. 2, plus switches to select appropriate resistors for each range. just trace the circuit to figure out which resistors are used on the range that has the problem.

In fact, knowing that on the  $R \times 1$  range, the Simpson 260 reads 12 ohms in the middle of the scale, we can calculate that  $R2 + R3 = 12$  ohms. The half-scale reading is what matters, of course; all ohmmeter ranges have 0 ohms at the right and infinity at the left. When you short the test leads together and the

**Electronics Now** and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

**Service manuals:** Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

**Replacement semiconductors:** Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

**Hamfests (swap meets) and local organizations:** These can be located by writing to the American Radio Relay League, Newington, CT 06111; (<http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

meter reads 0 ohms, it's putting 125 milliamperes through R2, R3, and the test leads, but we know the meter has a 50-microampere movement, so nearly all the current must be going through the shunt (R1).

Most likely, R1 has decreased in value or there is a short circuit across it. Also, it looks as if R2 has increased in value, or, more likely, you've set R3 very high.

Look for solder bridges and defective switch contacts, then try replacing R1. You can find the correct value by trial and error; try 2 ohms as a first guess, and use a precision resistor for the final repair.

By the way, do not use the  $R \times 1$  range to check circuits containing semiconductors or other delicate components—the heavy current can damage them. Use a digital meter for that.



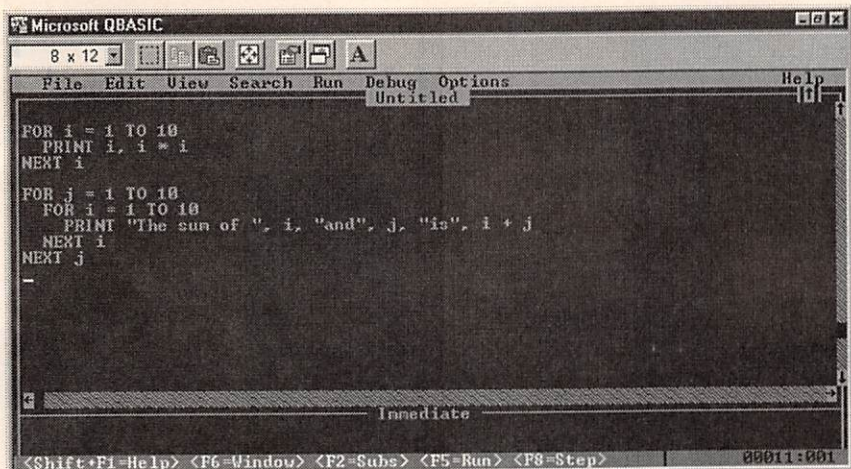


FIG. 3—QBASIC IS A DOS product that is still distributed with Windows 95 and 98.

## Back To Basic

**Q** I would like to know where to obtain updated versions of the useful do-it-yourself programming language BASIC. My versions are XBASIC and GW-BASIC, and they are 10 to 12 years old.—R. A. R., Los Angeles, CA

**A** You'll feel like Rip Van Winkle when you discover what BASIC has grown up to be.

BASIC (originally Beginner's All-purpose Symbolic Instruction Code) was invented at Dartmouth University in 1964 to give math students a quick way to do calculations on a computer. It remains a popular general-purpose programming language. Unlike Pascal, C, C++, and Java, which are based on particular theories of how programs ought to be constructed, BASIC is all practice, no theory. The language is essentially a collection of things programmers have found useful, and it keeps growing.

If you run Windows 95 or 98, or a late version of DOS, you probably already have Microsoft QBASIC (Fig. 3), a full-screen programming environment that includes instant online help so you don't need a manual. If you're a Windows user, you probably didn't install QBASIC, but you'll find it on your Windows 95 or 98 CD-ROM in a directory called \other\oldmsdos or \tools\oldmsdos, respectively. To install it, copy QBASIC.EXE and QBASIC.HLP into your \windows\ command directory and establish a shortcut to QBASIC.EXE. It's a DOS application and runs in a DOS window.

QBASIC will run all your GW-BASIC programs, but line numbers are no longer necessary because you have a

full-screen editor. Although QBASIC itself can't generate .EXE files, a related product, Microsoft QuickBasic, can do so; it's no longer marketed, but you can probably pick up a secondhand copy from an old-timer.

For Windows itself, Microsoft produces Visual Basic, a widely used professional program development environment (Fig. 4). Visual Basic lets you design windowed programs graphi-

cally, then write the BASIC code that should execute when the user clicks on each button or other object. You don't have to do the whole design at the beginning; you can add and delete objects and code at any time.

Visual Basic generates compact .EXE files that require a large .DLL file (supplied, and freely redistributable) in order to run. If you like the Visual Basic idea but would like to program in Pascal, C, or C++ and generate .EXEs that don't require a .DLL, try Inprise (formerly Borland) Delphi or C++ Builder respectively.

The alert reader will note that some time in the 1980s, between QBASIC and QuickBasic, Microsoft stopped writing BASIC in all capitals; we don't know why.

## Low-Power FM Transmitters

**Q** I live in a small community in northern British Columbia, Canada; am 13 years old; and ever since I was old enough to walk, I have been in love with science. Even

BREAST CANCER BEGINS EVEN SMALLER THAN THIS. THAT'S WHY YOU NEED A YEARLY MAMMOGRAM, ESPECIALLY AS YOU GET OLDER. MAMMOGRAMS CAN DETECT LUMPS TOO SMALL FOR YOU TO FEEL AND EARLY DETECTION MAY SAVE YOUR LIFE, SO CALL 1-800-ACS 2345.

GET A MAMMOGRAM. EARLY DETECTION IS THE BEST PROTECTION.

AMERICAN SOCIETY OF MAMMOGRAPHY TECHNOLOGISTS

## MAT ELECTRONICS

Over 20 years of dependable service to the industry

1999  
"The On Time Electronics Distributor"

SAVE \$5 ON ORDERS OVER \$100.00 • SAVE \$10 ON ORDERS OVER \$500.00  
1-800-628-1118  
FAX: 1-800-628-1005

**Call now for FREE 124 PAGE CATALOG!**

TV/VCR PARTS • CHEMICALS  
• SURVEILLANCE EQUIPMENT  
• AUDIO/VIDEO ACCESSORIES • MATV, CATV & DSS PRODUCTS • MICROWAVE OVEN PARTS • TOOLS AND SERVICE AIDS • BATTERIES • ANTENNAS • TELEPHONE ACCESSORIES • VIDEO GAME ACCESSORIES • COMPUTER PARTS & ACCESSORIES

**"The On Time Electronics Distributor"**

**CALL TOLL-FREE 1-800-628-1118**  
FAX: 1-800-628-1005

**MAT ELECTRONICS**  
400 Pike Road  
Huntingdon Valley, PA 19006

WEB SITE: [www.matelectronics.com](http://www.matelectronics.com)  
EMAIL: [sales@matelectronics.com](mailto:sales@matelectronics.com)



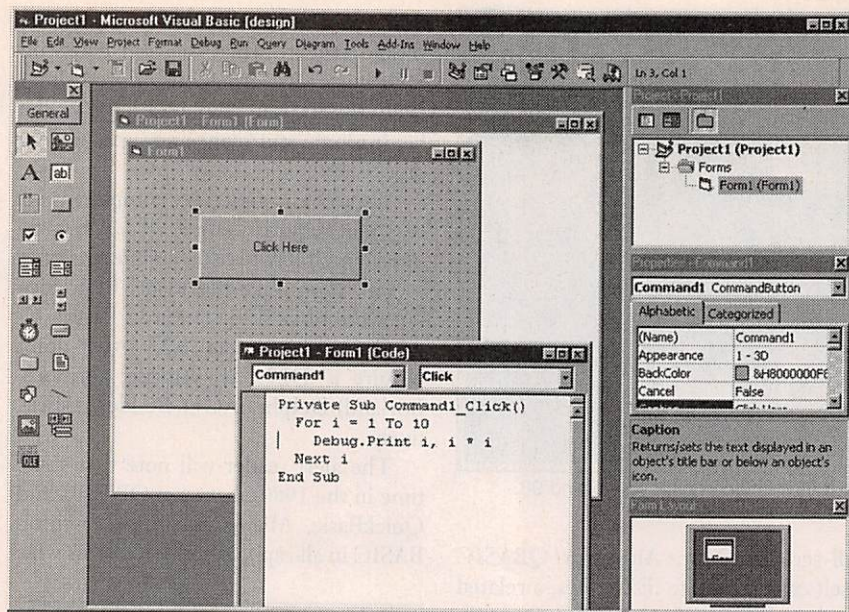


FIG. 4—VISUAL BASIC is a professional Windows programming environment based on the BASIC programming language.

though I'm a girl, I do a lot of "boyish" things (e.g., loving science, insects, reptiles), and my father has built me a lab down in the basement, complete with soldering station, electronic components, and microscope.

My friends and I have a 4-person "Mad Scientists' Club" and would like to have a way to communicate. Could you print some circuit diagrams of small, short-range FM radio transmitters that would transmit 5 or 10 miles?—K. S., Telkwa, B.C., Canada

**A** Keep it up—science needs more girls! Seriously, it's unfortunate the way so many girls are persuaded not to use their scientific or engineering talents.

The transmitters you describe will need a license for two reasons: the laws of Canada say so, and anything that can reliably cover 5 miles will sometimes interfere with communications 50 or 100 miles away. Thus, it's important to keep everything on carefully allocated frequencies.

Fortunately, you can get a license, as well as lots of information about how to build transmitters, by becoming a radio amateur (ham). For information, contact Radio Amateurs of Canada, 720 Belfast Road, Suite 217, Ottawa, Ontario K1G 0Z5, Web: [www.rac.ca](http://www.rac.ca) You do not have to learn Morse code in order to use FM above 30 MHz.

## Carbon Monoxide Detector

**Q** I have a CO (carbon monoxide) detector located in the basement, near the furnace.

If it goes off in the middle of the night, there's no way we can hear it from the second-story bedroom. Can you suggest a way to connect it to a buzzer or bell upstairs?—J. H., Belmont, MA

**A** You could probably just remove the sounder from a cheap CO detector and locate it elsewhere, connected by a long cable, but if you want real reliability—as you should, in a potentially life-saving device—it would be better to get a detector that is designed to connect to a fire alarm or other external indicators. Such detectors are available from Fireboy-Xintex, 100 Commerce Ave. SW, Grand Rapids, MI 49501-0152, Tel: 616-454-8337. Also contact local fire-alarm and boating-supply companies; both are likely to have CO detectors that are easy to interface to external alarms.

## Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to include plenty of background information (we'll shorten your letter for publication) and give your full name and address (we'll only print your initials). If you are asking about a circuit, please include a complete diagram. Send your questions to: Q&A, Electronics Now Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735. Due to the volume of mail, we regret that we cannot give personal replies.

## You can Build Gadgets! Here are 3 reasons why!

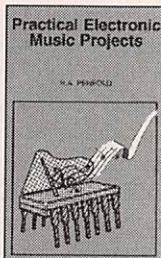
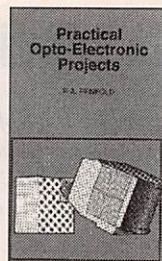


### ☐ BP345—GETTING STARTED IN PRACTICAL ELECTRONICS...\$6.99

If you are looking into launching an exciting hobby activity, this text provides minimum essentials for the builder and 30 easy-to-build fun projects every experimenter should toy with. Printed-circuit board designs are included to give your project a professional appearance.

### ☐ BP349—PRACTICAL OPTO-ELECTRONIC PROJECTS.....\$6.99

If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters—all are easy to build.



### ☐ BP363—PRACTICAL ELECTRONIC MUSIC PROJECTS.....\$6.99

The text contains a goodly number of practical music projects most often requested by musicians. All the projects are relatively low-in-cost to build and all use standard, readily available components that you can buy. The project categories are guitar, general music and MIDI.

Mail to:

**Electronic Technology Today, Inc.**  
P.O. Box 240  
Massapequa Park, NY 11762-0240

### Shipping Charges in USA & Canada

\$0.01 to \$5.00.....\$2.00	\$30.01 to \$40.00.....\$6.00
\$5.01 to \$10.00.....\$3.00	\$40.01 to \$50.00.....\$7.00
\$10.01 to \$20.00.....\$4.00	\$50.01 and above.....\$8.50
\$20.01 to \$30.00.....\$5.00	

Sorry, no orders accepted outside of USA and Canada. All payments must be in U.S. funds only.

☐ Number of books ordered.

Total price of books.....\$  
Shipping (see chart).....\$  
Subtotal.....\$  
Sales Tax (NYS only).....\$  
Total enclosed.....\$

Name.....

Address.....

City.....State.....ZIP.....

Please allow 6-8 weeks for delivery.

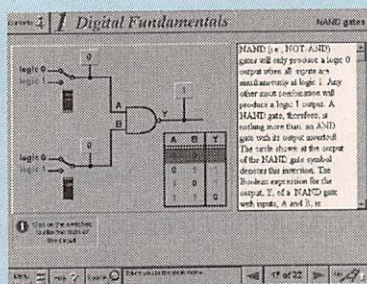




# EQUIPMENT REPORT

MATRIX MULTIMEDIA DIGITAL ELECTRONICS CD-ROM

*Learn the basic principles and concepts behind digital electronics at your own pace with this valuable interactive CD-ROM*



While some might not see it that way, the worlds of electronics and computers overlap a great deal. Computer-based virtual test gear has earned acceptance on many professional workbenches and is now making inroads with electronics hobbyists. Many of the electronic products you buy, and projects you build, have a microcontroller as their key component.

But computers can have another role, and one that is especially important to the electronics beginner. That is the role of teacher. There are many programs out there that help the novice gain insight into all the aspects of electronics. With those insights, an individual can get more out of his hobby, or perhaps take the first steps toward a rewarding career. In the realm of digital electronics, one of the best computer-based teaching aids we've seen is Matrix Multimedia's *Digital Electronics* CD-ROM.

The *Digital Electronics* CD-ROM is an interactive computer-based multimedia laboratory/textbook that moves along at whatever speed the user is comfortable with, teaching the basics behind digital electronics—the theories, circuits, parts, and all. While those already knowledgeable in digital electronics might not learn much new information from using this disc, beginners in digital theory will find it quite interesting. And those who don't want or need to learn about digital electronics might just want to have the disc around for informational purposes. *Digital Electronics* is writ-

ten by Mike Tooley and published in the UK by Matrix Multimedia Limited. It's available here in the United States for \$75 from CLAGGK Inc. (that price includes shipping in the US; foreign buyers must contact the company for shipping information).

## Digital Electronics

Intended for educational and training purposes, *Digital Electronics* is useful for teachers, students, and professionals. The disc includes all support materials and printable and editable worksheets, plus supervisor notes. Text on the disc can be heard by clicking a play button. System requirements are hardly steep: an IBM-compatible 486/25MHz or better PC, Windows 3.1 or Windows 95, a mouse, CD-ROM drive, VGA graphics with 256 colors, 8MB of RAM, about 10MB of hard-disk space, and a Sound Blaster-compatible sound card for audio playback.

*Digital Electronics* proved easy to install, and we were rummaging through its resources in minutes. A series of menus and sub-menus take the user through different lessons in digital electronics. Each lesson is accompanied by circuit diagrams, text, drawings, and photographs of actual parts. *Digital Electronics* introduces users to the principles of digital electronics, including logic gates, combination and sequential logic circuits, clocks, counters, shift registers, and displays. There's also an introduction to microprocessor-based systems.

What's interesting about *Digital Electronics* is that many of the circuits are "interactive." These circuits—logic circuits in particular—are shown in a steady state along with the logic states of each terminal listed on-screen. The user can toggle inputs to circuits and see the effect that the input conditions have on the output. It's a neat way to learn how digital circuitry works.

The first section of the disc covers digital fundamentals. This is where basic logic gates and truth tables are introduced. Also included are monostable and bi-stable circuits, master-slaves, various flip-flops, and more. Another section on combination logic covers circuits with multiple AND and OR gates, equivalent logic functions, comparators, parity checkers, scramblers, code converters, half- and full-adders, Karnaugh maps, Karnaugh simplification, and lots more.

The disc includes a section that covers sequential logic. Here you'll find clocks, counters, shift registers, and the like. Digital systems are also discussed, with details on traffic-light controllers, A/D and D/A converters, memory, microprocessors, and other critical sections of digital systems.

Along with all of the circuitry shown in the disc's many nooks and crannies, you'll find a section that includes a definition of basic logic gates, an introduction to the 7400 TTL series of integrated circuits as well as the CMOS 4000 series. A picture gallery shows many examples of digital circuitry and components.

While the *Digital Electronics* CD-ROM and some free time on a PC is no substitute for a college degree in electronics, it is a good resource to have on hand for electronics professionals and amateurs at all levels. It's also a great way for parents to introduce digital electronics to their children. To order Matrix Multimedia's *Digital Electronics* CD-ROM, contact CLAGGK Inc. (P.O. Box 4099, Farmingdale, NY 11735-0792; e-mail: claggk@poptronix.com) directly.

EN



# Monitor Deflection Circuits

**T**HIS MONTH, WE'LL ADDRESS THE BASIC PRINCIPLES OF OPERATION OF THE HORIZONTAL-DEFLECTION SYSTEMS USED IN MONITORS. WHILE MOST PEOPLE WITH ANY FAMILIARITY WITH TV OR MONITOR OPERATION OR REPAIR HAVE SOME VAGUE

idea of how these circuits work (probably just enough to be dangerous), many of their assumptions are incorrect or at least very incomplete. In addition to monitors, TVs (direct-view as well 3-CRT and light-valve projection types), tube-based video cameras (*e.g.*, vidicon), and other magnetically-deflected CRT devices also use the same techniques.

Note that vertical-deflection circuits are much less complex due to the lower scan rate (*e.g.*, 50 to 120 Hz as compared to 15.734 kHz for an NTSC TV or up to 120 kHz or more for a high-resolution computer monitor). Most of the control and output drive circuitry is contained in a special vertical chip in modern equipment.

TVs and most computer and video monitors depend on the use of similar (at least in concept) circuit configura-

tions to generate several outputs:

- Current waveform required in the deflection yoke coils of the CRT for linear sweep of the electron beam to create a high quality (geometry and linearity) picture. This is close to a sawtooth but not quite.

- CRT high voltage (20 to 30 kV or more) as well as other related voltages—focus and screen (G2).

- Various auxiliary power and signals for other subsystems of the equipment (low voltage, CRT filament, feedback, etc.).

## How It Works

Although there are many variations, the basic operation of the horizontal-deflection/high-voltage power-supply circuits in most TVs, monitors, and other CRT displays is very similar.

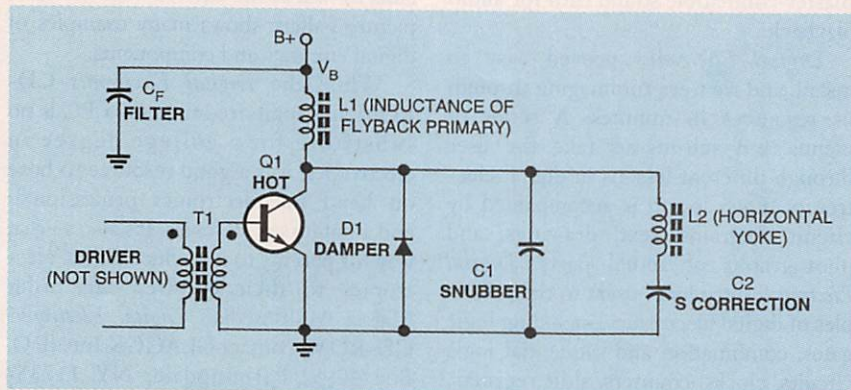
To better understand how the deflection circuit works, regard the flyback transformer as an inductor. The airgap stores energy, some of which might be tapped off during flyback by secondary rectifiers (*e.g.*, vertical deflection, signal circuits, and high-voltage supplies) and non-rectified loads (*e.g.*, filament supply), but those have hardly any influence on the basic working principles.

The scenario described next is only true in the steady state—the first few scans are different because the picture-tube capacitance is still discharged.

A very simplified circuit is shown in Fig. 1. Note that many components needed to create a practical design have been omitted for clarity.

We begin our adventure at the end of the scan—called retrace—when the flyback period begins. At the end of the scan, current is flowing through the flyback primary to horizontal-output transistor (HOT) Q1. At the start of the flyback period, Q1 turns off. (This must be done in a controlled manner—not just a hard shutoff to minimize stresses on the HOT—but that is another story). Since current in an inductor cannot change instantaneously, the current is diverted into the snubber capacitor, C1. The inductance of the flyback primary (L1) and C1 forms a resonant circuit so that the voltage climbs on C1 as the current goes down. At its peak, this voltage will be 1000 V to 1500 V. Snubber capacitor C1 now begins to discharge in reverse through the primary of L1 (back into the B+ supply—the filter capacitor will stabilize the B+ output) until its voltage (and also the collector-emitter voltage of the HOT) reaches 0.

If there were no damper diode (D1), that voltage would go negative and continue to oscillate as a damped sinusoid

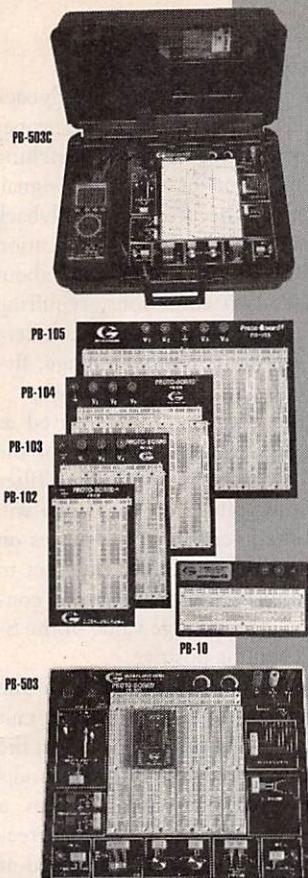


**FIG. 1**—A VERY SIMPLIFIED SCHEMATIC of a monitor's horizontal-deflection/high-voltage power-supply circuits is shown here. Note that many components needed to create a practical design have been omitted for clarity.



# Genuine Proto-Boards®

The benchmark in quality & reliability



If the breadboard you're using is not from Global Specialties, it's not a genuine Proto-Board®. And unless it's a genuine Proto-Board®, it's not built with the unmatched quality and craftsmanship only a Proto-Board® can offer. Don't compromise your best design efforts by using a cheap imitation. Put your trust in the name brand that has provided engineers and educators with maximum value for over 30 years - Proto-Board®.

Global Specialties offers powered and non-powered Proto-Boards®, designed to meet the most demanding prototyping applications. Select from a wide range of interlocking breadboards from our patented EXP and QT series sockets, or if it's test instruments in a desktop design workstation you require, select from a number of models designed to meet your technical, as well as economical needs. Each product is available either assembled or unassembled.

***There's only one Proto-Board®, and it's made by Global Specialties. Proudly made in the U.S.A.***



**GLOBAL SPECIALTIES**  
DESIGN & PROTOTYPING

800-572-1028 • FAX 203-468-0060 • [www.globalspecialties.com](http://www.globalspecialties.com)

CIRCLE 160 ON FREE INFORMATION CARD

due to the resonant circuit formed by L1 and C1 (and the other components). However, D1 turns on as the voltage goes negative and diverts the current through it, clamping the voltage near 0 ( $-V_F$  for the diode).

Note that in inexpensive or small screen TVs, damper-diode D1 may be built into the HOT. That's also true for some monitors that don't have any circuitry for E/W correction (more on that later).

The steps we've just described perform the flyback function of quickly and cleanly reversing the current in L2 (and, as we will see, the deflection yoke as well). The full flyback (and yoke current) are now flowing through the forward-biased damper diode, D1.

Therefore, at the beginning of scan, the damper diode (forward biased) carries the bulk of the current from the yoke and flyback. The nearly constant voltage of the B+ across L1 results in a linear ramp of current through the damper diode since it is still negative and decreasing in magnitude.

At approximately mid-scan, the current passes through zero and changes polarity from minus to plus. As it does so, the damper diode cuts off and the

HOT picks up the current (with a voltage drop of  $+V_{CE_{sat}}$ ). Current is now flowing out of the B+ supply.

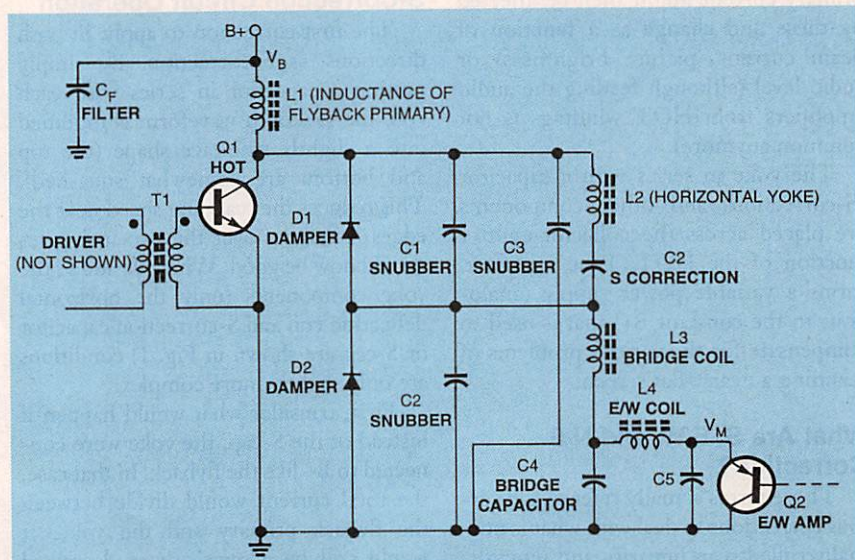
Note that the base-drive to the HOT must have been switched on at some time before this point!

During the second half of the scan, the HOT current ramps up approximately linearly. That is again due to the

nearly constant voltage of B+ across the inductance of the flyback primary.

Near the end of scan, the HOT turns off and the cycle repeats.

Thus, the current in the flyback (ignoring the yoke components) is a nearly perfect sawtooth. The ramp portion is quite linear due to the essentially constant B+ across the flyback primary's



**FIG. 2—**HERE THE E/W CORRECTION circuit has been added to the power supply of Fig. 1. Again, note that this is a simplified schematic.



inductance. The current waveform can be easily viewed on an oscilloscope with a high-frequency current probe. I'll even tell you how to build one safely for next to no cost in a future installment!

The voltage across the collector-emitter junction of the HOT is a half sinusoid pulse during the flyback (scan retrace) period and close to zero at all other times ( $-V_F$  of the damper diode during the first half of scan;  $+V_{CEsat}$  for the HOT during the second half of scan).

**Caution:** Without a proper high-frequency, high-voltage probe, it is not possible or safe to observe this point on an oscilloscope with full B+. However, where the equipment can be run on a Variac, this clean pulse waveform can be observed at very reduced B+. Excessive ringing or other corruption would indicate a problem in the flyback, yoke, or elsewhere.

The current through Q1 and D1 is several amps peak-peak. There's a lot of power circulating here, making this a **dangerous** circuit in every way!

## The Deflection-Yoke Connection

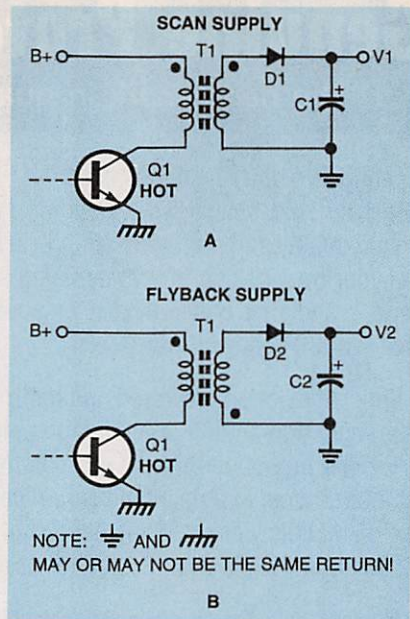
So, you ask: "Why can't the yoke just be placed in series or parallel with the flyback primary?" There are several reasons including:

- The desired yoke current is not quite a sawtooth, but includes two major corrections: S and E/W (described below). These cannot be applied easily with such a configuration.
- The flyback also generates the HV and secondary output voltages, and the primary current might then be affected by these and change as a function of beam current (picture brightness) or audio level (although feeding the audio amplifiers from HOT windings is not common anymore).

The yoke in series with a capacitor (S-correction) and other components are placed across the collector-emitter junction of the HOT. That, in effect, forms a variable power supply (analogous to the constant B+) that is used to compensate for the various problems of scanning a nearly flat screen.

## What Are S, E/W, and N/S Correction?

Those terms actually refer to the various corrections to deal with what is normally called scan linearity and pincushion distortion. Most larger TVs and nearly all high-quality monitors will



**FIG. 3**—THE CIRCUIT IN A is just a typical example of an auxiliary supply derived from a scan rectifier. The circuit in B is an example of the use of a flyback rectifier.

have various user and internal controls to optimize the corrections for each scan rate (multiscan monitors).

Because the screen of most CRTs is relatively flat (even those not advertised as flat) and the electron gun is relatively close, any picture tube would naturally have serious linearity problems and pincushion distortion if there were no corrections applied. The spot will move faster near the edges and corners of the screen because the same angular speed translates to a larger linear speed.

## S-Correction Circuit Operation

The first correction to apply, in both directions, is S-correction. By simply putting a capacitor in series with each coil, the sawtooth waveform is modified into a slightly sinewave shape (the top and bottom are somewhat squashed). This reduces the scanning speed near the edges. Linearity over the two main axes should now be good. When we add in the yoke components (only the horizontal deflection coil and S-correction capacitor or S-cap are shown in Fig. 1) conditions are only slightly more complex.

First, consider what would happen if instead of the S-cap, the yoke were connected to B+ like the flyback. In that case, the total current would divide between the flyback primary and the yoke. It would still be a sawtooth as described above. Of course, component values would need to be changed to provide the

proper resonant circuit behavior.

That's called "tuning of the flyback capacitor." The goal is to get the proper duration of the flyback pulse, matching the blanking time of the video signal, and to achieve the proper peak flyback voltage, matching the  $V_{CES}$  specification of the HOT with a reserve of about 20%. That's two conditions, requiring two degrees of design freedom. There are three freedoms: supply voltage, flyback capacitor, and yoke inductance.

With the S-cap and yoke wired as shown in Fig. 1, the inductance of the yoke and S-cap form a low-pass filter such that the voltage on the S-cap will be a smoothed version of the pulses on the HOT collector (similar in effect to the B+ feeding the flyback but not a constant value). The average value of the S-cap voltage will be positive.

The S-capacitor together with the yoke inductance forms a resonant circuit whose frequency is tuned lower than the line frequency. It has the effect of modifying the sawtooth current into a sinewave shape. This is called "S-correction." It reduces the scanning speed at the left and right edges of the screen.

The value of the S-cap can be selected so that the voltage varies in such a way as to squash the current sawtooth by the appropriate amount to largely compensate for the fact that the electron beam scans a greater distance with respect to deflection angle near the edges of the screen.

Think of it this way: When the scan begins, the yoke current is at the maximum value in the direction to charge the S-cap. The voltage across the S-cap is causing the current to decrease, but the S-cap is also gaining charge, so the rate of decrease is increasing. At the time the current passes through 0, the S-cap is charged to its maximum. The current now reverses direction, retracing its steps. This is an example of a portion of a resonant circuit. The voltage on the S-cap is varying by just the right amount to compensate for the geometry error.

For multiscan monitors, S-caps must be selected for each scan range since the timing varies with scan rate. These are only approximate corrections, but are good enough for most purposes. MOS-FET or relay circuits are used to select the correct combination of S-correction capacitors for each range of scanning frequencies.

As an example, consider a multiscan monitor that supports VGA (31.4 kHz,



800 × 600 at 56 Hz (35 kHz), and 800 × 600 at 60 Hz (38 kHz):

For good geometry between 31, 35, and 38 kHz, two discrete values for the S-cap are barely enough. Actually a third value optimized for 35 kHz would be better. If there is only one S-cap and it is optimized for 38 kHz, then at 31 kHz you will be using a too large an angle of the sine (of the resonant frequency between the S-cap C and the deflection coil inductance). Possibly even more than 180 degrees, making the current fold back. Apart from an obvious geometric distortion, there is also increased risk of HOT failure because you're operating too close to the resonant frequency.

### E/W Correction-Circuit Operation

There are also N/S and E/W errors, meaning that near the corners the scanning speed is still too large. To a large extent the N/S errors can be corrected by a suitable yoke-coil design. For smaller tubes (90 to 100 degrees types) that could also take care of E/W errors. However, for larger (110 degrees) or high-quality tubes, electronic E/W correction is required. E/W errors are what cause the well-known pincushion effect.

E/W correction is modulation (which implies multiplication) as a function of the vertical-beam position. The amplitude of the horizontal-deflection current is modulated with a parabola waveform that is derived from the vertical-deflection circuit. That squeezes the top and bottom lines back into the left and right screen borders.

This is how the diode modulator for E/W correction works (refer to Fig. 2 as we proceed):

The deflection supply B+ gives a constant voltage  $V_B$ . At the output of the E/W amplifier there is a variable voltage  $V_M$ . Because there can not be an average voltage over any coil, the average voltage over the deflection circuit ( $L_2 + C_2$ ) is  $V_B - V_M$ . The scanning width is proportional with this voltage. Modulating  $V_M$  as a field-frequency parabola that is higher for the top and bottom lines causes the scanning width to be reduced for the corners of the screen.

The required field-parabola waveform is derived from the field-deflection circuit. Amplitude and DC-level are adjustable as needed for correcting pincushion distortion and setting the screen width.

The E/W amplifier usually has a PNP emitter follower only, because it must only sink current and dissipate a bit of power. Coils  $L_3$  and  $L_4$  ensure that the E/W amplifier sees no line-frequency. The "bridge" components,  $L_3$  and  $C_5$ , resemble the deflection coil with its S-correction capacitor and carry the large amplitude alternating current. The  $L_3/C_5$  circuit is tuned to approximately the same frequency as the  $L_2/C_2$  circuit.

Capacitors  $C_1$ ,  $C_3$ , and  $C_4$  must be tuned so that EHT is independent of  $V_M$  and peak voltage over  $D_2/C_2$  is high enough but not too high when Q2 is off. Capacitor  $C_4$  is usually a small (approximately 1 nF) ceramic capacitor mounted close to the HOT (Q1); it also suppresses EMI. Flyback capacitors are critical components. Wrong types may overheat and burn. Bad contacts here or elsewhere in the deflection circuit might arc and also cause fire.

There are many variants to this circuit, e.g. for dynamic S-correction. Multi-sync monitors need added circuitry to make the EHT independent of the line frequency (if there is not a separate EHT supply, that is).

If the E/W modulator fails, you will see that the top and bottom lines will be much too wide. There are several parts that could have failed. It's usually not too difficult to find why there's no parabola. If you have partial loss of E/W modulation, notably in the extreme corners, then you should suspect the tuning of the three flyback capacitors that belong to the diode modulator circuit. That's a specialist job...

### S-Correction Problems

So, then, what are the problems associated with the S-Correction capacitor, and what are their symptoms? Here goes:

- An open S-cap will result in no horizontal deflection—a vertical line.
- A shorted S-cap will likely load down the B+ possibly resulting in a blown fuse or other power supply components.
- An S-cap that changed value (or in the case of a multiscan monitor, selected to be the wrong value) will result in distortion at the left and right sides of the screen. If it is too low, the picture will be squashed towards the edges. If it is too high, the picture will be stretched towards the edges.

Note that this is not the same as what is commonly called linearity, which

would likely affect only one side or gradually change across the screen.

### Horizontal-Linearity Correction

Since there is a non-zero resistance associated with the components (mainly coil losses) in the yoke circuit (yoke winding, ESR of S-cap, etc.), the world is not quite as ideal as one would hope. Without compensation, that resistance would result in non-linearity of the picture—it would tend to be squashed on the right side as the resistance saps energy from the yoke circuit.

The waveform becomes a damped sinewave, which will be "undamped" by restoring energy during the flyback.

One way to deal with this is to add a magnetically biased saturable inductor in series with the horizontal-deflection yoke. That inductor is called the linearity coil.

Its core is magnetically biased near the point of saturation such that the inductance decreases with increasing current, and that helps to stretch the right-hand side of the scan. In other words, during the scan the coil saturates so that the inductance decreases. At the end of scan there is practically no voltage left over the linearity coil, so that the deflection coil gets maximum voltage.

### E/W Correction Problems

The common name for the adjustment controls is likely to be "Pincushion Amp" and "Pincushion Phase." They affect the E/W correction circuits. Pincushion Amp adjusts the amplitude of the correction signal. Pincushion Phase adjusts where the correction is applied on the vertical scan.

Problems in the E/W correction circuits will show up as follows:

- Failure of the E/W correction circuit will result in very noticeable pincushioning distortion of the vertical edges.
- Excessive E/W correction will result in barrel distortion of the vertical edges.
- A bad power supply derived from the flyback could also result in similar symptoms due to ripple or lack of power to the pincushion circuitry.

### N/S and E/W Circuit Differences

While the desired effects are largely the same—modulate the amplitude of one component of the deflection circuit (H or V) by the other (V or H), the implementations of the N/S and E/W circuits



will differ substantially. The reasons should be obvious: The line frequency is much higher than the field frequency.

E/W correction is easy—the lower frequency modulates the higher frequency. That reduces to simple amplitude modulation. Well, simple in principle. The line circuit is a high-energy circuit. That's why the diode modulator circuit has been invented for this application. It allows an energy exchange between the line-deflection circuit and a pseudo deflection circuit.

N/S correction is difficult—the higher frequency modulates the lower frequency. It can be done with sort-of amplitude modulation by using a "transductor." This is not a transformer but a component with 2 coils and a saturable core where the current through 1 coil modulates the inductance of the other coil. If there are tuned parts in the circuit, then the correction will be highly sensitive to line-frequency variations.

It can also be done with a regular transformer by injecting a strong signal (from an amplifier) with line-frequency components into the field-deflection circuit.

Either way, it's an expensive solution that should be avoided by designing the deflection coils so that the picture tube needs no active N/S correction.

## Deflection Derived Power Supplies

Several types of auxiliary power may be obtained from the flyback, somewhat as a byproduct of the deflection-system operation.

Although not always well known, the coupling factor with the primary is decent for a flyback transformer, and so there can be scan rectifiers as well as flyback rectifiers.

- Scan power is obtained during the forward stroke as with a "normal" transformer. Energy is transferred while the HOT/damper diode is conducting. The output rectifier is oriented so that current flows during scan time (dots on the transformer winding match). See Fig. 3A.

Scan rectifiers make no use of the stored magnetic energy; they load the primary directly during the scan part. They do not cause an increase of the stored magnetic energy, so a heavy load is not a problem.

- Flyback power is obtained from the stored energy in the flyback transformer's inductance when the HOT shuts off. The output rectifier is oriented

ed so that current flows at flyback time (dots on the transformer windings oppose). See Fig. 3B.

Unlike scan rectifiers, flyback rectifiers (especially the EHT) draw from the stored magnetic energy. When the secondary load increases, the magnetization current will also increase. Ultimately this will cause saturation of the ferrite core. Excess beam current is a common cause for this and should be avoided by the beam-current limiter. The advantage of a flyback rectifier is that it provides 7 times more volts per winding than a scan rectifier.

- AC power (usually only for the filament or a feedback signal) flows during both scan and flyback.

## EHT (High-Voltage) Generation

The EHT (Extra High Tension or HV to the CRT) is generated from a secondary winding on the flyback transformer having several thousand turns of very fine wire. Being a flyback supply, the actual output voltage is many times what would be calculated based on turns ratios alone. The HV rectifier consists of a stack of silicon diodes with a total PIV rating of 50 KV or more. Because the flyback pulse is so narrow, the rectifier diode will conduct only a short time. Thus the peak current in the winding will be quite high, resulting in a significant voltage drop when loaded. The internal impedance of the EHT source is in the order of 1 megohm, so with a load of, for example, 1 mA, the EHT will drop  $1000\text{ V} = -3\%$ . Usually the EHT voltage is far from stable; a 10% drop is quite normal.

If the EHT voltage drops, then the electrons will be accelerated less and will move through the deflection field at a lower velocity. As a result they will be easier to deflect by the magnetic field, and the picture size will grow. Without special measures, brighter pictures will be larger. The way to prevent that is to feed some EHT information or beam-current information to the deflection circuits, reducing the deflection current amplitude a bit for bright pictures. For horizontal deflection, that is done by the E/W modulator. This technique is called anti-breathing.

Sets with raster-correction-free picture tubes don't have an E/W modulator. There the correction might be done by means of a power resistor in series with the B+ supply. A large beam current causes more power consumption; this

lowers the B+ supply voltage and thus reduces the line-deflection current. That also reduces the EHT even further, but the deflection current has a stronger effect on the picture width than the EHT. Better methods exist as well.

The EHT information is also used to protect the flyback transformer from overload. As the load increases, the average primary current rises. Ultimately it may reach a level where the transformer core may go into saturation. This causes large peak currents in the HOT, which might lead to destruction. To prevent that, some EHT information is fed to the contrast controller to automatically reduce the picture brightness whenever the white content is too high. That is called the average beam-current limiter.

A failure in the video path, like a video output amplifier stuck at 0 V, causes a high beam current that will not react to the contrast controller. In that case, the beam-current limiter will not work; and the set should switch off automatically, usually within a few seconds after applying power. When the cathodes heat up, you'll see an even picture with diagonal retrace lines, and then it will switch off.

## "Real-World" Circuits

Don't expect to find the circuits shown this month to be staring you in the face when you get your Sams' *Photofacts* or service manual. There are a semi-infinite number of variations on this basic theme. Some of them will, to put it mildly, appear quite obscure (or to put it more positively, creative) at first.

You might see all sorts of additional passive components as well as transformers for generating additional voltages not provided by the flyback. There could be diodes in places you would think would be impossible. Therefore, to really understand even approximately how each design works could require some head scratching—but the basic operation of them all seems to be very similar.

## Wrap Up

That's it for now. Next time we will continue our discussion of deflection-system operation with some information about horizontal-output transistors and deflection system problems. Until then, check out my Web site: [www.repairfaq.org](http://www.repairfaq.org). I welcome comments (via e-mail please at [sam@stdavids.picker.com](mailto:sam@stdavids.picker.com)) of all types and will reply to requests for information. See you next time!



# Intel's Coming CPUs

**I**F YOU'RE A REGULAR READER OF THIS COLUMN, YOU MIGHT HAVE NOTICED THERE'S A DIFFERENT NAME LISTED ABOVE. RATHER THAN GOING INTO A LONG-WINDED INTRODUCTION, LET ME SIMPLY TAKE THIS OPPORTUNITY TO SAY THAT I'M

delighted to take over this assignment and happy to be able to promise many great installments of *Computer Connections* in the coming months and years.

Expect hands-on advice for upgrading your PC, as well as details on just what makes its components (both old and cutting edge) tick. If it's a new technology, application, or industry trend, there's a good chance you'll find it covered in these pages. We don't need to stress how important computers are to the electronics world (and *vice versa*); and if you want to be a hands-on part of the state of high-tech, you have to keep abreast of the PC world.

While other magazines rely primarily on computer product reviews, this column will focus on making you truly savvy about what's inside (or could soon be inside) that cream-colored box on your desk. To get things started, this and next month we'll be focusing on the most important component in a PC. We're talking, of course, about the CPU. While in the past picking a computer was an easy decision (most people would simply look for the highest CPU clock speed they could afford), it's now become a task performed in a blurry market. Intel is no longer the only company supplying chips.

How do you decide which CPU is best for your needs? Sure, all new processors are touting some pretty high clock speeds. But are all, say, 350-MHz chips created equal? Not by a long shot. Find out who

the players are, how their products stack up, and, perhaps most interesting of all, what secrets these vendors have in store for us throughout the coming year.

We've got some secrets to share.

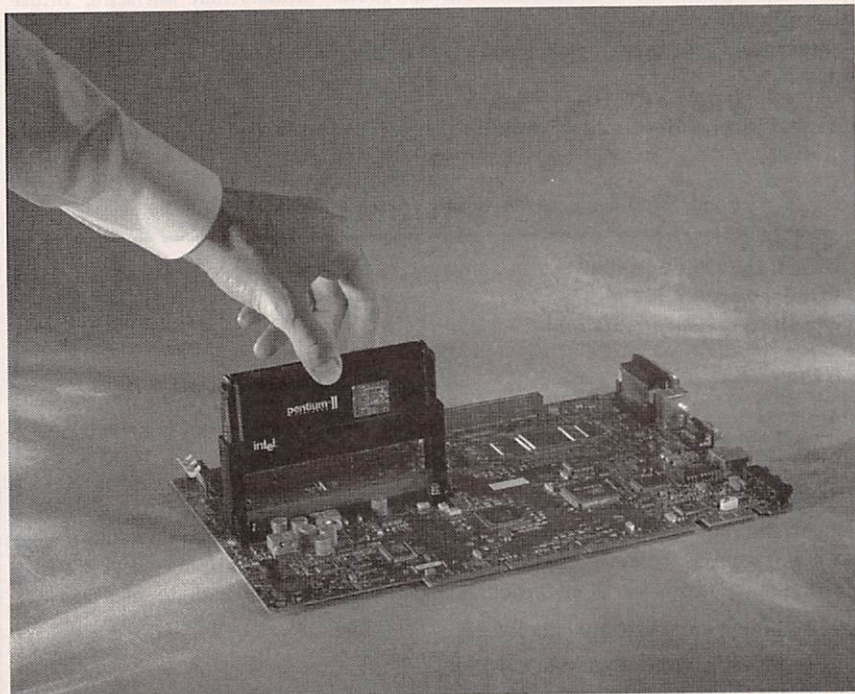
## The Father Of It All

No discussion of CPU manufacturers can begin without an analysis of what

Intel's up to—in fact, its past and future contributions are so significant that we'll only be dealing with this giant Santa Clara corporation this month. We will deal with Intel's competition (such as AMD) in detail next time.

Since the first days of the home PC, Intel has pretty much dominated the silicon market for these devices. The engineers there have come a long way, too. Within the past couple of years alone, Intel has come out with several groundbreaking technologies.

The real beginning of the hyper jumps that CPUs have been making recently was MMX Technology. These new instructions, which were added to



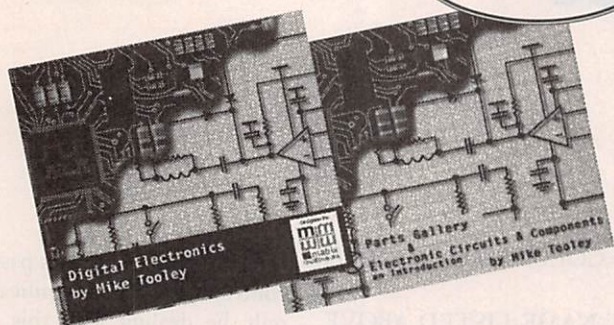
INTEL'S PENTIUM II WILL REMAIN THE FASTEST CPU in town this year, with Katmai 3-D-enhanced versions being released soon in 450- and 500-MHz clock speeds. The new PIIIs will still use the single-edge contact cartridge form factor.



# ELECTRONICS CD ROMs

*The most effective way of  
learning Digital Electronics*

Complete Course  
on CD ROM!  
Only \$74.99



Digital Electronics builds on the knowledge of logic gates covered in Electronic Circuits and Components, and takes users through the subject of digital electronics up to the operation and architecture of microprocessors. The included virtual laboratories allow users to operate many circuits on screen.

## Digital Fundamentals

Starting from the very basic principles of logic gate operation, Digital Electronics guides users through Boolean algebra, combinational and sequential logic to complex digital systems such as A/Ds and DACs, memories and microprocessors. Virtual Laboratories and worked examples help to build students' confidence and promote understanding.

## Combinational Sequential Logic

Multiple gate circuits, equivalent logic functions, and specialised logic functions such as majority vote, parity checker, scrambler, half and full adders. Includes fully interactive virtual Laboratories for all circuits.

Sequential Logic, Digital Systems, and a Gallery of commonly used IC schematics are also included!

- Virtual Laboratories
- Worked Examples
- Full Audio Commentary

See and Test a demo version at <http://www.MatrixMultimedia.co.uk>

Clagck Inc., PO Box 4099  
Farmingdale, NY 11735-0792  
e-mail: [clagck@poptronix.com](mailto:clagck@poptronix.com)



Name \_\_\_\_\_ Phone \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Enclosed is \$74.99 for each student version of *Digital Electronics* on a single CD ROM, shipping included inside the U.S. Shipping costs to Canada an additional \$3.00. Overseas orders please contact CLAGCK, Inc. for shipping costs. I am ordering (....) copies at \$74.99 each. NY State residents must include sales tax.

☐ I have enclosed my check for \$ \_\_\_\_\_  
☐ Please charge my credit card for \$ \_\_\_\_\_  
☐ Visa ☐ MasterCard ☐ Discover Expiration Date \_\_\_\_/\_\_\_\_  
Card Number \_\_\_\_\_ Signature \_\_\_\_\_

(Name on order and signature must be the same as on Credit Card.)

the old x86 instruction set, helped CPUs perform about 10 to 20 percent better when running multimedia software designed for MMX. It was Intel's first real step toward bringing to the world a more "visual" PC.

Then came the real rocket: Pentium II. While the Pentium was an impressive chip, it's literally only half as impressive as a PII with a similar clock speed. In short, a typical 233-MHz Pentium II machine will benchmark almost twice as fast as a 233-MHz Pentium with MMX. (Just to clarify, all Pentium II chips have MMX Technology, but all Pentiums do not, which is why we differentiate when the latter has it present, and say "Pentium with MMX" or "MMX Pentium.")

What makes PII so powerful? For starters, the core of the chip contains 7.5 million transistors—about twice as many as a typical MMX Pentium. Like MMX Pentium CPUs, the Pentium II has two separate 16K, on-chip Level-1 caches, which run at processor speed and provide fast access to heavily used data. However, the PII also has a closely coupled 512K Level-2 cache that helps achieve higher performance.

Having an L2 cache right in the processor package—the PII comes in a single-edge contact cartridge (SECC) form factor—eliminates data-transfer speed bottlenecks. Rather than the L2-cache bus controller used in the older Socket 7 architecture, where the L2 cache was separate on the motherboard, a dedicated 64-bit bus handles transfer between the processor and L2 cache housed within the silicon and does so at half the processor speed.

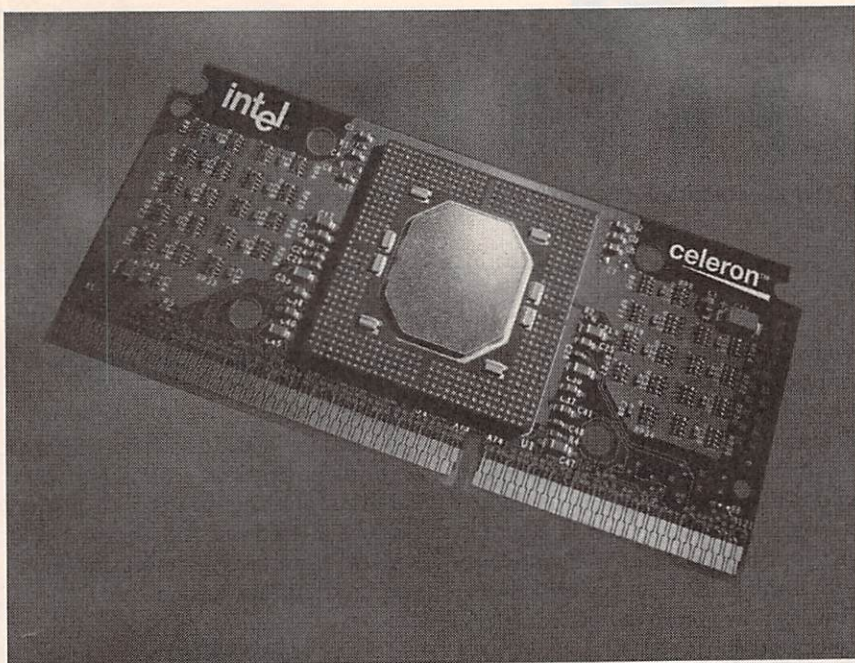
The Pentium II's Dynamic Execution Technology is another great boost to its power, allowing the CPU to execute instructions out of order and take full advantage of each clock tick. Better yet, the Pentium II can speculate as to which instructions might be needed in the near future and perform those in advance.

## VENDOR INFORMATION

**Advanced Micro Devices (AMD)**  
One AMD Pl.  
P.O. Box 3453  
Sunnyvale, CA 94088-3453  
(800) 538-8450  
[www.amd.com](http://www.amd.com)

**Intel Corp.**  
2200 Mission College Blvd.  
Santa Clara, CA 95052-8119  
(408) 765-8080  
[www.intel.com](http://www.intel.com)





IF YOU OPEN UP A PII CARTRIDGE, remove the board inside, and then reduce that board's L2 cache to 128K, you end up with a basic PC chip known as Celeron. Intel will be bringing out 366- and 400-MHz versions of the CPU this year.

The chip is also superscalar, which means its internal pipeline architecture lets it execute multiple transactions simultaneously.

Another boon to the Pentium II's speed is the dawn of Deschutes technology. While in the past processors were being manufactured with 0.35-micron traces, Intel got that distance between traces down to 0.25 microns, cutting down on power use and increasing clock frequencies (electrons don't have to travel as far). As we'll see later on, the Deschutes manufacturing process will not be this year's miniaturization limit.

Combined with the 440LX and later 440BX chipsets, the Pentium II has remained the fastest chip available for a PC. From benchmark testing, we have concluded that MHz for MHz, no other CPU outclasses the PII yet. For this reason, the Pentium II's performance is the standard against which all competitors will be judged. Again, more on them next month.

### 3-D Wars

Chances are that you've already heard of AMD's 3DNow! technology. With all the print and TV advertising going on, it's pretty hard not to have noticed the hype. That might lead some people to believe that AMD has finally beaten Intel in terms of innovation—after all, Intel hasn't released a 3-D in-processor technology yet. However, the truth is a bit

more complicated than that.

The idea of in-chip 3-D technology is to enable a CPU to handle more floating-point operations per clock tick (say, four instead of one). It is floating-point operations that handle most of the multimedia magic that appears onscreen. With extra floating-point horsepower available, game and graphics-program designers can write code that performs more smoothly yet doesn't overload a PC video system. AMD was indeed the first company to release such a technology.

However, while 3DNow! technology is available in the K6-2 processor (more on this chip next month), AMD's market share is still not so large that software developers can easily invest in supporting the K6-2. There are a couple of games that have 3DNow! patches available for download, but the majority of vendors are instead busying themselves preparing for the release of what's certain to be a faster 3-D CPU with more market penetration—Intel's Katmai.

Which brings us to this month's real "goody"....

### Intel's Roadmap

As you might have guessed, processor manufacturers know quite a bit in advance what CPUs they're going to bring out. We got Intel to share with us a few of its secrets for the rest of the year. Because of space considerations, we'll only be dealing with desktop

processors. Laptop chips and technology will be a topic for another day.

If all goes as scheduled, Intel's much-awaited Katmai processor will soon be appearing in desktop computers. This is a Pentium II with 3-D enhancements in the form of 70 new instructions. But the fact that almost every software manufacturer on the planet is writing to support Katmai is not its only benefit over 3DNow! Katmai can handle real-time MPEG-2 encoding, which will make it possible to record DVD-quality video and audio on your computer.

The new PII will launch in clock speeds of 450 and 500 MHz. While there is currently a 450-MHz PII, Katmai's floating-point enhancements will make both chips perform faster than existing PII's. Katmai will also use the 440BX chipset, which means that current 350- to 450-MHz Pentium II systems may be upgradeable to the chip (depending on whether the BIOS can handle or be upgraded to handle the CPU).

In addition to its high-end performer, Intel will also expand its Celeron line of processors this year. Soon after this issue hits the stands, Intel should be announcing a 366-MHz version of this "basic PC" chip. Like its 300- and 333-MHz predecessors, the new Celeron is basically a Pentium II with only a 128K integrated L2 cache. Expect a 400-MHz Celeron soon after.

Moving back to the high-end CPUs, we have to address the exciting advances coming in the second half of '99. As you might have guessed, we will definitely see faster-than-500-MHz chips. The first of these from Intel is code-named Coppermine, because of its new copper-interconnect assembly technology. This is a cheaper method of creating CPU traces and will result in faster chips because it is a 0.18-micron process. While Intel is sketchy on the details, expect Coppermine to use a bus speed that's even faster than the 440BX—maybe 133 MHz? We'll likely see 600-MHz Coppermine chips this year, if not faster ones.

And that's pretty much what Intel has in store for the desktop PC market. Join us here next time for a look at what the competition is up to. If you'd like to drop me a line in the meantime, feel free to e-mail me at [connections@gernsback.com](mailto:connections@gernsback.com), or send a USPS letter to *Computer Connections*, **Electronics Now**, 500 Bi-County Blvd., Farmingdale, NY 11735.





# NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

## Hardware Simulator

OFFERING LOW-COST SYSTEM debugging for base-line PICmicro 8-bit RISC microcontrollers, such as PIC12C5XX, PIC12CE5XX, and PIC16C5XX, the SIMICE hardware simulator works in conjunction with Microchip's MPLAB-SIM software simulator to provide non-real-time I/O port emulation.

SIMICE enables a developer to run simulator code for driving the target system. The target system can give input to the simulator code, which allows simple and interactive debugging without having to manually generate MPLAB-SIM stimulus files. Features of this simulator include unlimited software breakpoints, PC communication via serial interface at speeds up to 57k baud, and support of source-level debugging.

MPLAB Integrated Development Environment (IDE) reduces microcontroller development time by giving users the flexibility to edit, compile, and emulate, as well as program, all devices from a

single user interface. A project manager and program text editor, a user-configurable toolbar containing four pre-defined sets, and a status bar that communicates editing and debugging information are contained in the MPLAB software. A dynamic error capability allows rapid application development with a simple click on any error listing, returning the user to the source code for quick editing.

MPLAB is available for free by downloading the software program from the Web site listed below. The complete SIMICE Hardware Simulator system features a hardware I/O port emulator board, RS-232 cable, PICmicro target probe cables, and MPLAB IDE software. For more information, contact any Microchip sales representative or authorized worldwide distributor. SIMICE has a list price of \$129.

### MICROCHIP TECHNOLOGY, INC.

2355 W. Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 602-786-7668  
Fax: 602-899-9210  
Web: [www.microchip.com](http://www.microchip.com)

## Dual-Display Digital Multimeter

DESIGNED TO PROVIDE PRICE/performance value, the Model 2880A is a high-performance, dual-display DMM. This hand-held device is ideal for use in electronic and electrical field service, plant maintenance, and engineering/R&D applications.

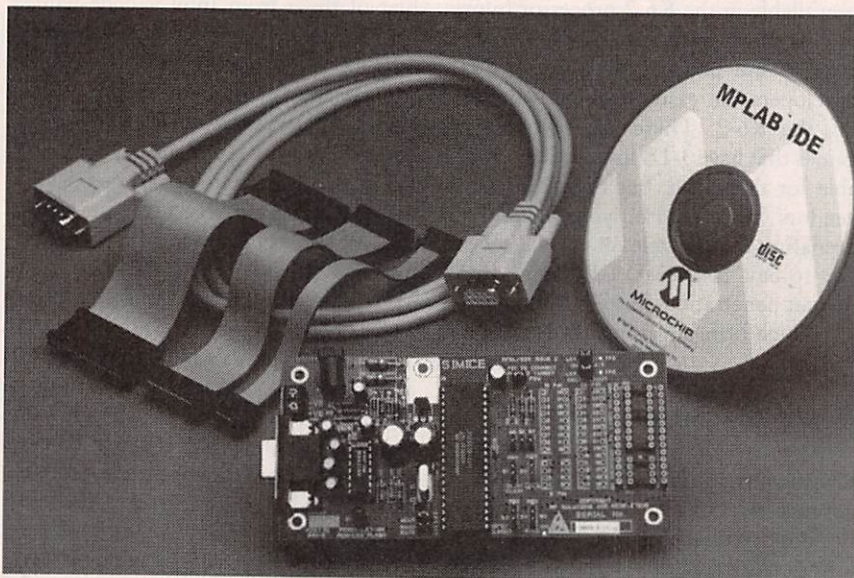


CIRCLE 21 ON FREE INFORMATION CARD

"These products offer unique and useful features not normally found in a typical DMM, especially at this price," said Mark Albert, director of marketing, as well as "...RS-232 computer interface and the added functionality of in-depth, long-term signal analysis utilizing the dual display."

Other features include two user-selectable operating resolutions (4000/40,000 counts), voltage to 1000VDC/750 VAC, and current to 10 amps. There is also a dual-display providing frequency to 200 kHz with AC signal measurement, resistance to 40 megohms, and capacitance to 9999  $\mu$ F, as well as diode check and continuity. User-friendly features, such as: data hold, relative mode (displays the difference between a set input and subsequent inputs), and max/min/avg reading of an input with an elapsed timer, make this a very practical test instrument for the professional or serious hobbyist.

The 2880A offers true rms measurements to accurately display non-linear and traditional loads and is IEC1010-1 Cat III approved. An optional accessory



CIRCLE 20 ON FREE INFORMATION CARD



# Take control of today's technology!

**NRI Schools now gives you a fast, easy way to break into the high-tech industry as a PC Servicing Technician**

## With NRI's PC Servicing course,

you can get the practical skills and experience to service any computer with confidence. From diagnostic software to CD-ROM tutorials to a high-end computer system, NRI gives you the technological tools and training you need to carve out a successful new career, even start a business of your own!

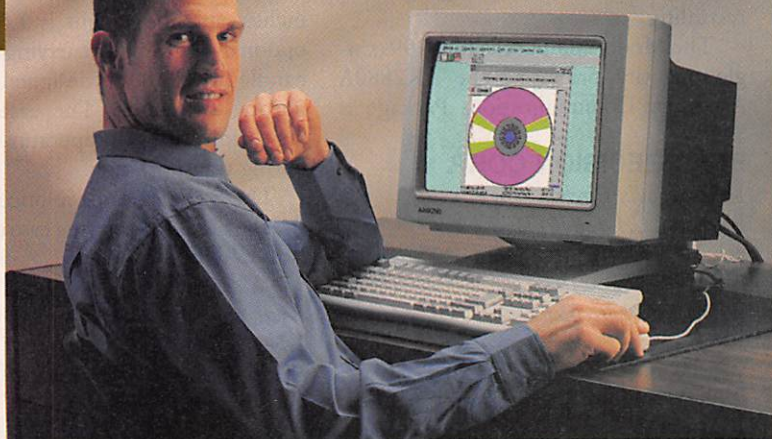
## Learn essential PC servicing skills with these unique course features:

- CD-ROM training from Norton interactive—designed by acclaimed software developer Peter Norton, this unique training tool has realistic simulations, special effects, full-color graphics, and role-playing lessons.
- ForeFront Troubleshooter™ Software and CD-ROM pinpoints system failures and diagnoses faulty components.
- Troubleshooting training—includes McGraw-Hill's easy-to-follow guides on troubleshooting and interactive computer-aided electronics diskettes relating to four key areas: AC electronics, DC electronics, semiconductors, and electronic circuits.
- Windows 98—this long-awaited version of Windows has more power, a new Web look, e-mail capabilities, single-click functionality, and System File Checker.

**You'll also perform hands-on experiments with NRI's exclusive labs: computer-aided electronics demonstrations, 8085 Microprocessor, and NRI Discovery Lab, a complete breadboarding system.**



**Your training includes a Pentium® II 400 personal computer, with MMX™ technology, 64 meg RAM, 5 gigabyte hard drive, Super VGA color monitor, 32X CD-ROM drive, and 56K baud fax/modem**



## A+ Certification—a credential that counts!

Your value as a computer service technician will soar with coveted A+ Certification. With NRI, you get essential study tips, test-taking strategies, and supplemental lessons, plus interactive tutorials and practice tests on CD-ROM. As you prepare for the exam, you'll also benefit from online support from NRI's personal instructors.

You cover these important exam subjects:

- Diagnosing & Troubleshooting
- Memory Management
- Networks
- Operating Systems
- Printers
- Portable Systems
- and more!



**Call or send for FREE information:**

**1-800-321-4634**

**Ext. 3539**

**or reach us online at: [www.nrischools.com](http://www.nrischools.com)**

**NRI Schools**

4401 Connecticut Avenue, NW  
Washington, DC 20008

☒ **YES!** Send me free information on how NRI can prepare me for a high-tech computer career. Check one box only.

- |   |   |
|---|---|
| <input type="checkbox"/> <b>PC Servicing</b>        | <input type="checkbox"/> Computer Programming     |
| <input type="checkbox"/> Networking With Windows NT | <input type="checkbox"/> Telecommunications       |
| <input type="checkbox"/> Industrial Electronics     | <input type="checkbox"/> Computer-Aided Drafting  |
| <input type="checkbox"/> Mastering Microsoft Office | <input type="checkbox"/> Bookkeeping & Accounting |

Name \_\_\_\_\_ Apt. # \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

A Division of The McGraw-Hill Companies

Accredited Member, Distance Education and Training Council

0003-0399



package that includes software and a cable with an optical receiver that connects to the meter permits RS-232 communication between the 2880A handheld DMM and a PC. The software allows for saving, loading, making reports, displaying multimeter readings, printing data and controlling data recording.

The Model 2880A sells for \$199 (single quantity pricing). The AK2880A Accessory Communications Package is \$15.

#### B&K PRECISION CORP.

1031 Segovia Circle  
Placentia, CA 92870-7137  
Tel: 714-237-9220  
Fax: 714-237-9214  
Web: [www.bkprecision.com](http://www.bkprecision.com)

### High-Accuracy Resistance Standards

THE SRL SERIES IS A VIRTUALLY zero temperature coefficient set of high-accuracy resistance standards. The series exhibits virtually zero TC near 23°C and typically less than 1 ppm change between 18 and 28°C.

Tests have shown this series to be highly stable, usually varying less than 1 ppm per year, yet the SRL Series is more economical and cost effective than other standard resistors. The SRL standards are available in a broad range of values, from 1 ohm to 19 megohms. Other IET series extend from 1 megohm to 190 gigaohms. Custom values and special values suitable for RTD (Resistance Temperature Detectors), such as 25 ohms, are available.

There are four 5-way binding posts for 4-terminal measurement and two binding posts for 1 megohm and over. The binding posts are constructed of tellurium copper for low thermal EMF

and low resistance. A case ground terminal is also provided.

These compact standards, which are designed not to require an oil bath, are much more convenient to use than the older can types that need tedious temperature bath stabilization. The dimensions of the standards are 3.4 × 4.2 × 5 inches, and the weight is 1.6 lbs. The optional lightweight carrying case with handle (SRC-100) is designed for transporting two units. The case provides insulation from temperature changes during transportation.

The SRL Series basic price is \$1569, and the SRC-100 carrying case costs \$185.

#### IET LABS, INC.

534 Main St.  
Westbury, NY 11590  
Tel: 516-334-5959  
Fax: 516-334-5988  
Web: [www.ietlabs.com](http://www.ietlabs.com)

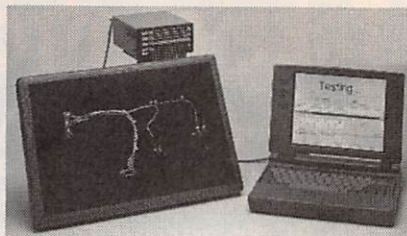
### PC-Based Harness Tester

WITH WINDOWS-BASED SOFTWARE and features such as sequential and random build/test modes, single and continuous test, and graphical guided-assembly capabilities, the *easy-wire* CR harness/backplane tester makes harness assembly and testing easier and more efficient.

The CR offers on-screen graphical representations of connectors, sound prompts for correct/incorrect wire placement, and blinking LEDs on the harness board to guide assembly. Among the additional features are repetitive continuous testing and the ability to add wire names and colors. The data base can be backed up to import and export across networks for multiple testing.

These features make it easy for operators to quickly learn an assembly and to identify wiring errors and defects (opens, shorts, miswires, twisted-pair defects, and terminations with high resistance) as the harness is built. The tester's small size (each 256-point box measures 5.4 × 6.6 × 2.6 inches and weighs under 3 lbs.) and daisy-chain architecture allow users to distribute the test points around the device under test, reducing the length and complexity of the interface cabling. With expandability up to 65,024 points, the *easy-wire* CR should meet the largest test requirements.

The *easy-wire* CR Base Unit (256 points) has a list price of \$1745. Scanner Add-ons (256 points) cost \$895 each.



CIRCLE 23 ON FREE INFORMATION CARD

#### CIRRISS SYSTEMS CORP.

1991 Parkway Blvd.  
Salt Lake City, UT 84119  
Tel: 800-441-9910  
Fax: 801-973-4609  
Web: [www.cirris.com](http://www.cirris.com)

### All-Mode Transceiver

IDEAL FOR PORTABLE, MOBILE or fixed (base) operation, the IC-746 is a DSP, high-performance radio. Featuring all-mode performance, including FSK (RTTY) on all bands and HF through two meters, the receiver has a host of interference-fighting abilities. Among them are twin passband tuning, auto



CIRCLE 24 ON FREE INFORMATION CARD

notch, and audio peak filtering.

Three additional (optional) IF filters can be accommodated for maximum selectivity. Weak signal reception is enhanced by the IC-746's IF DSP features and its two-stage preamplifier (single-stage on 2 meters). There is also variable digital noise reduction and a noise blanker.

The compact IC-746 (approximately 11½ × 4¾ × 12½ inches and weighing under 20 lbs.) provides 100 watts of output on all modes and all bands, including two meters. A band scope is included on the large, easily read display window to monitor band activity. Standard on the IC-746 is a full-featured memory keyer, including a serial number generator for contests and an adjustable weight control. A triple-band stacking register and 100 memories (with alphanumeric tagging capability) offer maximum operation capability.

The transceiver's auto-tuner for



CIRCLE 22 ON FREE INFORMATION CARD



160-6-meter operation has memories for tuner settings every 100 kHz for quick, efficient antenna tuning. Three antenna inputs are provided on the IC-746.

The IC-746 has a suggested list price of \$2228.

#### ICOM AMERICA, INC.

2380 116th Avenue NE

Bellevue, WA 98004

Tel: 425-454-8155

Fax: 425-454-1509

Web: [www.icomamerica.com](http://www.icomamerica.com).

## Notebook Digital Camera

THE FIRST DIGITAL CAMERA built especially for notebook computers users, the PDR-5 offers out-of-the-box functionality with Windows and Macintosh notebooks. Designed as a companion for on-the-go professionals—field engineers, project managers, security personnel and marketing staff—the camera is optimized for notebook use because its back-panel doubles as a built-in PC Card interface.

To use the PC Card, simply flip it open, and plug it into any Type II slot. Once the card is inserted, the computer automatically recognizes it as a drive for file-transfer purposes. The JPEG format images are then retrieved via Sierra Imaging's drag-and-drop Image Expert Album software format on the computer screen, thus simplifying photo selection.

With the PDR-5, there is no scanning and no film developing. Its VGA-quality images are instantly available on a notebook, and it can be used to create e-mail attachments; Web-page graphics; professional-looking brochures, flyers and field reports; as well as for presentations.

Other outstanding features of the digital camera include: a wide-angle 39mm all-glass lens with macro, a reflective 2.5-inch color LCD, SmartMedia storage, video-out, and a four-mode flash. The camera weighs just 6.4 ounces and fits inside a shirt or jacket pocket.

Accessories for the PDR-5 include a long-life CR123A lithium battery, a hand strap, a 2-MB SmartMedia card, and a carrying case. The estimated street price is \$399.



CIRCLE 25 ON FREE INFORMATION CARD

## TOSHIBA AMERICA INFORMATION SYSTEMS, INC.

### IMAGING SYSTEMS DIVISION

9740 Irvine Blvd.

Irvine, CA 92618

Tel: 800-288-1354

Fax: 800-640-8674

Web: [www.toshiba.com/taisis](http://www.toshiba.com/taisis)

## Switching Power Supply

THE 25-AMP MIGHTYLITE switching power supply can power HF transceivers or 2-meter/440 MHz mobile or base and accessories in the shack, or anywhere else you need it. Its three-inch dual meters are brightly illuminated to make it easy to monitor voltage and current.



CIRCLE 26 ON FREE INFORMATION CARD

MightyLites are so lightweight and small that they can be carried in the palm of the hand—no more heavy, bulky power supplies. The 25-amp version, the MFJ-4225MV, weighs just 3.7 lbs., five times lighter than an equivalent switching power supply, and measures only 5¼ by 4½ by 6 inches.

The unit features a front-panel voltage control to vary the output voltage from 9 to 15 VDC and yields a highly regulated voltage output. It gives less than 35 mV of peak-to-peak ripple and a better than 1.5% load regulation under a 25-amp full load. Users won't hear hash in the signal, and their buddies won't hear it on their end either.

The MFJ-4225MV has three sets of output terminals, including a pair of heavy-duty five-way binding posts and a cigarette lighter socket for mobile accessories. In addition, in the rear there are two sets of quick-connects for accessories.

The power supply is fully protected with over-voltage and over-current protection circuits and with a quiet internal fan to cool it. The MightyLite is fused, has a switchable AC input voltage, works from 85 to 135 VAC, meets FCC Class

B regulations, and provides 25 amps maximum or 22 amps continuous.

The MFJ-4225MV sells for \$149.95. The MFJ-4245MV MightyLite, a 45-amp version, is also available for \$199.95.

## MFJ ENTERPRISES, INC.

P.O. Box 494

Mississippi State, MS 39762

Tel: 800-647-1800

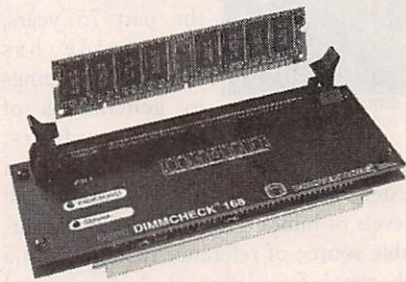
Fax: 601-323-6551

e-mail: [mfj@mfjenterprises.com](mailto:mfj@mfjenterprises.com)

Web: [www.mfjenterprises.com](http://www.mfjenterprises.com)

## SDRAM Memory Tester

WITH THE COMPUTER INDUSTRY's move to the Intel PC100 motherboard standard, there is a great demand for true 100-MHz testing equipment. The 125-MHz test engine and the 1-ns speed resolution technology of the Sync DIMMCHECK 168 adapter combine to provide an affordable testing solution for SDRAM and standard EDO/FPM 168-pin DIMM modules.



CIRCLE 27 ON FREE INFORMATION CARD

The adapter snaps into the Simcheck II or Simcheck IIse. With the push of a single button, the fully automatic test programs allow even non-technical personnel to test memory. The adapter quickly tests the module's functionality, size, speed, type, and gives detailed structure information.

It then proceeds with full SDRAM mode tests and comprehensive Page Burst and Blank Interleave tests. The Sync DIMMCHECK 168 adapter provides full support for SPD data (Serial Presence Detect), including reading, editing, and programming. The adapter retails for \$995.

## ARISTO COMPUTERS, INC.

6700 SW 105th Avenue, Suite 300

Beaverton, OR 97008-5484

Tel: 800-3ARISTO or 503-626-6333

Fax: 503-626-6492

Web: [www.aristocom.com](http://www.aristocom.com)



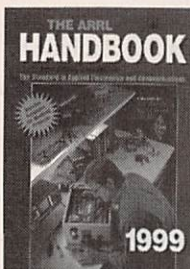


# NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

## The ARRL Handbook for Radio Amateurs: 1999 Edition

edited by R. Dean Straw, N6BV  
American Radio Relay League  
225 Main Street  
Newington, CT 06111-1494  
Tel: 800-243-7767  
Fax: 860-594-0303  
e-mail: itardette@arrl.org  
Web: [www.arrl.org](http://www.arrl.org)  
**\$32**



CIRCLE 338 ON FREE INFORMATION CARD

The 76<sup>th</sup> edition of the handbook maintains its reputation as the best all-around electronics reference. Over the past 75 years, this guide has meant many things to generations of hams, students, engineers, and technicians. It's been an extensive resource for projects for all levels of building experience, an invaluable source of reference material, and a thorough foundation of electronics and communications theory.

This 1200-page book has served as an overview of what hams do and how they do it. For newcomers to the hobby, it's provided an introduction to the modes and equipment hams use, as well as to the theory.

The new projects in this edition include a 13.8-V/40-A switching power supply, a legal-limit Svetlana 4CX1600B amplifier, and a voice keyer, as well as an enhancement to the high-power antenna tuner introduced in the Handbook's last edition. In response to reader's comments, this volume includes PC templates for the weekend projects. The larger more complex templates are on the ARRL Web site listed above.

The handbook is divided into 30 chapters grouped under five headings: Introduction, Fundamental Theory, Practical Design and Projects, Construction Techniques, and Operating

Practices. In addition, the software for the book is now available separately. It can be downloaded from either the League's Web site or from its Hiram BBS, or it can be ordered for a nominal cost.

## ECG Semiconductor Master Replacement Guide, 18th Edition

from Philips ECG  
Tel: 800-526-9354  
Web: [www.ecgphilips.com](http://www.ecgphilips.com)  
**Free**



industry and commercial and industrial companies. The most comprehensive, single source of replacement information available today, the 18<sup>th</sup> edition of this guide features new products, new product families, additions to existing lines, and approximately 300,000 cross-references. Using the expanded cross-reference guide and other selector guides makes it easy to select the best ECG part for an application.

ECG now offers the most complete user cross-reference library in the industry—the entire data base has been updated from the recently published 212T Master Guide and the software has been upgraded. The Philips ECG Instant Cross program is available in both DOS format and Microsoft Windows

The latest ECG Master Replacement Guide contains a wide variety of high quality replacement devices for the entertainment

3.1 and 95.

Philips ECG semiconductors are available through a global network of distributors. The *ECG Semiconductor Master Replacement Guide, 18th Edition* is free upon request from your local distributor. Contact Philips ECG at the phone number or Web site listed above to locate the nearest distributor.

## Stopping Spam

by Alan Schwartz and Simson Garfinkel  
O'Reilly & Associates, Inc.  
101 Morris Street  
Sebastopol, CA 95472  
Tel: 800-998-9938 or 707-829-0515  
Fax: 707-829-0104  
Web: [www.oreilly.com](http://www.oreilly.com)  
**\$19.95**



CIRCLE 339 ON FREE INFORMATION CARD

Why are we getting spam—junk messages, unsolicited ads, come-ons, and pornography in our e-mail mailboxes, and newsgroups—and who is sending them? This book answers these questions about unwanted e-mail messages and inappropriate news articles, discussing what can be done about them and how they can be stopped and even outlawed. According to the authors, "Spam is the Internet's version of junk mail and telemarketing calls ... all rolled into a single annoying electronic bundle."

Meant for everyone who surfs the net; for administrators of systems, newsgroups, and networks; and for Internet service providers (ISPs); *Stopping Spam* covers methods to help stop junk e-mail. The top three weapons in this battle are keeping your e-mail address private or disguising it, using filters, and registering complaints about spam to ISPs.

In addition to technical details, readers will find entertaining stories about famous Internet chain letters and court

## BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1456 or visit on the web at <http://www.BooksNow.com/popular-electronics.htm>.

Free catalogs are not available.



cases. This book is enjoyable and timely, and it arms you against Internet abusers.

## Winter 1999 Short Form Designer's Guide

Analog Devices  
One Technology Way  
P.O. Box 9106

Norwood, MA 02062-9106

Tel: 800-262-5463 or 781-329-4700

Fax: 508-894-5114

Web: [www.analog.com](http://www.analog.com)

Free



CIRCLE 340 ON FREE INFORMATION CARD

Analog Devices designs, manufactures, and sells sophisticated electronic components and subsystems for use in signal processing. In the last year, they introduced more than 100 new products,

bringing their total product lines to over 1500 items. To provide maximum usefulness to designers of new equipment, the contents of the selection guide are limited to products most likely to be used for the design of new circuits and systems.

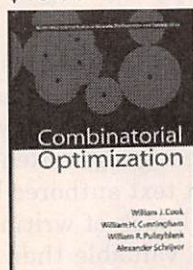
This catalog is organized for quickly narrowing the product search using its "Trees" or "Selection Guides." The text begins with an introduction to new products, including AD $\mu$ C812 Micro-Converters; dual access accelerometers; and DSP processors, such as the ADSP-21061. At the back of this volume, readers will find a list of older products still in production, as well as a guide to substitutions and those part numbers that are on lifetime buy.

This publication, coupled with the CD-ROM (available separately), makes for a paper/paperless data book. Once readers have found a solution, they can print the data sheet from the CD-ROM or use the Web or the faxback system to download it. The CD-ROM contains all the data sheets, along with parametric search engines, application notes, SPICE models, and a cross-reference guide.

## Combinatorial Optimization

by William J. Cook, William H. Cunningham, William R. Pulleyblank, and Alexander Schrijver

Wiley-Interscience  
John Wiley & Sons, Inc.  
605 Third Avenue  
New York, NY 10158-0012  
Tel: 212-850-6336  
\$49.95



CIRCLE 341 ON FREE INFORMATION CARD

One of the most vital areas of applied mathematics, combinatorial optimization integrates techniques from combinatorics, linear programming, and the theory of algorithms. Because of its success in solving

difficult problems in areas from telecommunications to VLSI and in areas from product distribution to airline crew scheduling, the field has grown over the past decade.

Written by a team of experts, the text offers a thorough, highly accessible treatment of both classical concepts and recent results. It is an ideal introduction to this mathematical discipline for advanced undergraduates and graduate students of discrete mathematics, computer science, and operations research. Topics include network flow problems, optimal matching, integrality of polyhedra, matroids, and NP-completeness.

Featuring logical and consistent writing, clear explanations, real-world examples, and helpful exercises, this volume is sure to become a standard in the field.

## 1998/99 Jensen Tools Catalog

Jensen Tools Inc.  
7815 S. 46th Street  
Phoenix, AZ 85044-5399  
Tel: 800-426-1194  
Fax: 800-366-9662 or 602-438-1690  
e-mail: [jensen@stanleyworks.com](mailto:jensen@stanleyworks.com)  
Web: [www.jensentools.com](http://www.jensentools.com)

Free



CIRCLE 342 ON FREE INFORMATION CARD

Jensen Tools—supplier to the electronics industry since 1954—has completely redesigned and expanded their catalog; this edition is 308 full-color pages. This comprehensive reference guide features premium

Jensen-brand products, including 50 pages of original JTK tool kits, a new line of high quality handheld JTM multimeters, and an extensive selection of hand tools.

Over 5000 total products from all major manufacturers are available, including test equipment, computer and LAN support, wire and cable, telecom, power tools, soldering, storage and handling, work stations, lighting and optical, shop supplies, and communications products. Hundreds of new products—many new to the industry—have been added.

A complete online catalog with secure e-commerce is also available at the Web site above.

## Semiconductor Material and Device Characterization, 2nd Edition

by Dieter K. Schroder  
Wiley-Interscience  
John Wiley & Sons, Inc.  
605 Third Avenue  
New York, NY 10158-0012  
Tel: 212-850-6336  
\$89.95



CIRCLE 343 ON FREE INFORMATION CARD

Devoted to the characterization techniques used by the modern semiconductor industry to measure diverse semiconductor materials and devices, this book covers the full range of electrical and optical characterization methods, while thoroughly treating the more specialized chemical and physical techniques. It is a practical and an essential reference for research and development in the industry, as well as for students at the graduate level.

This edition covers the many innovations in the field during the last decade. The easy-to-use text includes a real-world mix of units, rather than strictly MKS units. From the detection of metallic impurities in silicon wafers to

**BooksNow**

To order books in this magazine or any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1456 or visit on the web at <http://www.BooksNow.com/popular-electronics.htm>.

Free catalogs are not available.



## BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1456 or visit on the web at <http://www.BooksNow.com/popularelectronics.htm>.

Free catalogs are not available.

the use of microwave reflection to measure contactless resistivity, each chapter presents state-of-the-art tools and techniques. There are numerous examples, and end-of-chapter problems have been added for this edition. In addition, there's a new chapter on reliability and probe microscopy. Five hundred illustrations were also revised.

## 1999 Catalog

*Antique Electronic Supply*  
6221 South Maple Avenue  
Tempe, AZ 85283

Tel: 602-820-5411

Fax: 800-706-6789 or 602-820-4643

e-mail: [info@tubesandmore.com](mailto:info@tubesandmore.com)

Web: [www.tubesandmore.com](http://www.tubesandmore.com)

Free



CIRCLE 344 ON FREE INFORMATION CARD

Offering the most diverse line of products for all types of tube gear, including vacuum tubes, transformers, capacitors, parts, supplies, and literature, this 72-page catalog contains many new products.

Among them are ferrite rods, inductor coils, gift items, a line of Hammond classic 300-series power transformers, a line of telegraph keys, books, and many other products. There are also newly packaged "Screamin' Deals."

The telegraph keys are high quality, beautifully made, and reasonably priced; and they are great gifts for the ham in your life. Three types of keys are available: straight key, iambic paddle, and a dual straight key and iambic paddle. They are imported from Spain, have gold-plated brass keys on an olive wood base, and the handles and knobs are teakwood.

EN

# Books that Bridge Theory & Practice

Many electronics enthusiasts discovered that the bridge from classroom theory books to hands-on project building is difficult to span at times without a handy pocket guide. Even the equipment manual to operate a gadget often makes things murkier rather than clearer. A compact text authored by a seasoned expert with hands-on knowledge and a knack of writing in an easy-to-understand style is many times more valuable than the price of ponderous theory and equipment manuals or the parts for a project that could be damaged. Here's a sampler of some titles you may want to own!

**ELECTRONIC HOBBYIST DATA BOOK**—The info you need to transport you from the schematic diagram to project parts. Pin-outs, color codes, truth tables, parts parameters, etc. **Order BP396— \$10.99 Includes S & H**

**PRACTICAL INTRODUCTION TO SURFACE MOUNT DEVICES**—A technology that spun off the automated assembly line into the grasp of experimenters and project builders. **Order BP411— \$9.99 Includes S & H**

**THE INTERNET AND THE WORLD WIDE WEB**—The most difficult part of the Internet is its mystery. Erase the mystery and you'll become the super surfer with a little help from this book. **Order BP403— \$10.99 Includes S & H**

**PRACTICAL OSCILLATOR CIRCUITS**—If your budding project requires an oscillator, you can design it and build it from the many types described here in a hobbyist-friendly style. **Order BP393— \$9.99 Includes S & H**

**EASY PC INTERFACING**—Hot shot Pentium computers to the lowly XT slow poke can interconnect to the outside world to sense and/or control events governed by simple writeable software and simple home-brew projects. **Order BP385— \$9.99 Includes S & H**



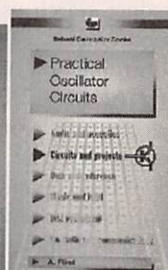
BP396



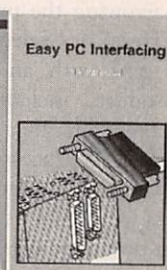
BP411



BP403



BP393



BP385

## Electronics Technology Today Inc.

P.O. Box 240

Massapequa, NY 11762-0240

Number of books ordered

Amount enclosed \$

Please send me the following book(s) that I checked:

- ☐ BP396— Electronic Hobbyist Data Book— \$10.99  
☐ BP411— Practical Introduction to Surface Mount Devices— \$9.99  
☐ BP403— The Internet and the World Wide Web— \$10.99  
☐ BP393— Practical Oscillator Circuits— \$9.99  
☐ BP385— Easy PC Interfacing— \$9.99

All above prices include shipping and handling.

Name/Company

Address

Apt.

City

State

ZIP

Sorry, no orders accepted outside the USA and Canada. All payments must be in US funds! NY state residents must include local sales tax. Allow 6-8 weeks for delivery.

# BUY BONDS



# Prototype

## Crash-Data Recorders for Your Car

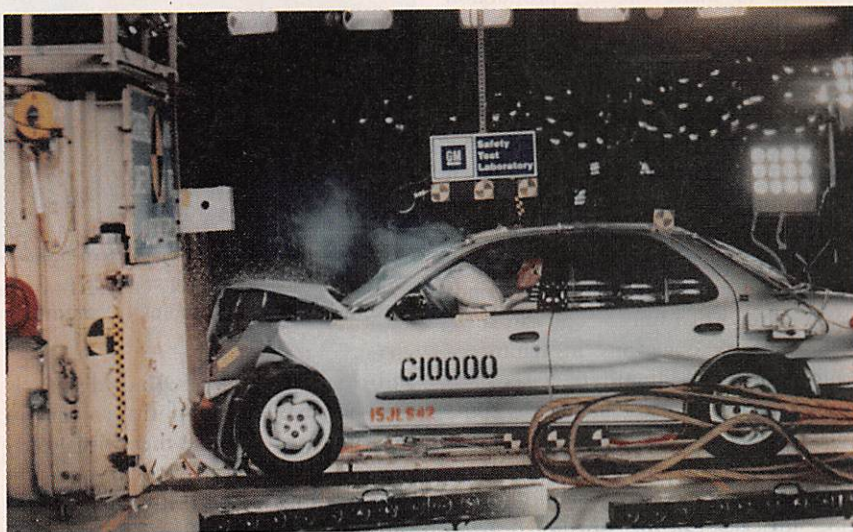
**A**s tragedy has shown us, the "black boxes" carried by airliners are often the most important source of evidence in helping the investigators determine the precise reasons for an aircraft crash. Now that same concept is moving to the family automobile: Though less sophisticated, nine different 1999 General Motors cars feature "black box" crash-data recording capability. The 1999 models scheduled to be fitted with the new system include the Buick Century, Park Avenue and Regal; Cadillac Eldorado, Deville and Seville; Chevrolet Camaro and Corvette; and Pontiac Firebird.

The system, which GM calls an advanced event-data recorder, is an enhancement of the air-bag sensing and diagnostic module (SDM) that has been installed in GM-built vehicles for several years. The SDM records information about the readiness of the air-bag systems when the sensors are activated and if the driver's safety belt is being used at air-bag deployment or in a near-deployment crash.

### Gathering More Information

The new enhanced system adds vehicle speed, engine RPM, throttle position, and brake use for the five-second period before the crash. The data is captured in one-second intervals by a method conceptually similar to an endless-loop tape. Actually, the term "black box" is a misnomer since enhancements included in the SDM required no additional hardware, just connections to a local area network within the vehicle so the SDM can "talk to" the other computers and sensors in the vehicle.

In the event of a crash, an SDM senses any frontal impact and determines when to deploy the air bags. Now it also provides a signal to store the data on four additional parameters taken during



NOT ONLY WILL AIR BAGS DEPLOY in frontal crashes. In many 1999 General Motors cars, but five seconds of critical pre-crash data will be recorded that could help reconstruct the accident and provide information for designing safer vehicles.

the previous five seconds. The recorded data can be retrieved even if the battery is disconnected or the SDM box is unplugged.

The enhanced SDM stores information whenever a severe impact causes the air bags to deploy; under certain circumstances, it may also store data for a "near-deployment" event. An impact at about 12 mph or greater into a rigid barrier will trigger data collection as will a crash into a parked car at 24-30 mph. Data storage will occur only during frontal collisions—the major cause of death or serious injury in crashes.

### Making Safer Cars

Like black boxes in airliners, which provide important research data that can prevent future crashes, event data recorders installed in automobiles could also help design safer vehicles. Last year, the NTSB recommended to the National Highway Traffic Safety Administration (NHTSA) and the automotive industry that they "gather better

information on crash pulses and other crash parameters in actual crashes, utilizing current or augmented crash sensing and recording devices." This system answers this recommendation.

The GM advanced event data recorder will provide significant real-world data to improve automotive safety. Researchers will have new information on how drivers react to hazards and interact with their vehicles. That information can help provide critical insight into crashes and resulting injury patterns. The bottom line is data that can eventually lead to improved designs that are more crashworthy.

Post-crash reconstruction will also be easier and more precise thanks to these units. Data from the recorders will be available to augment data collected by law-enforcement and insurance investigators. Future vehicle-defect investigations and rule making can also benefit by having a more objective and scientific basis.—By Bill Siuru

PT



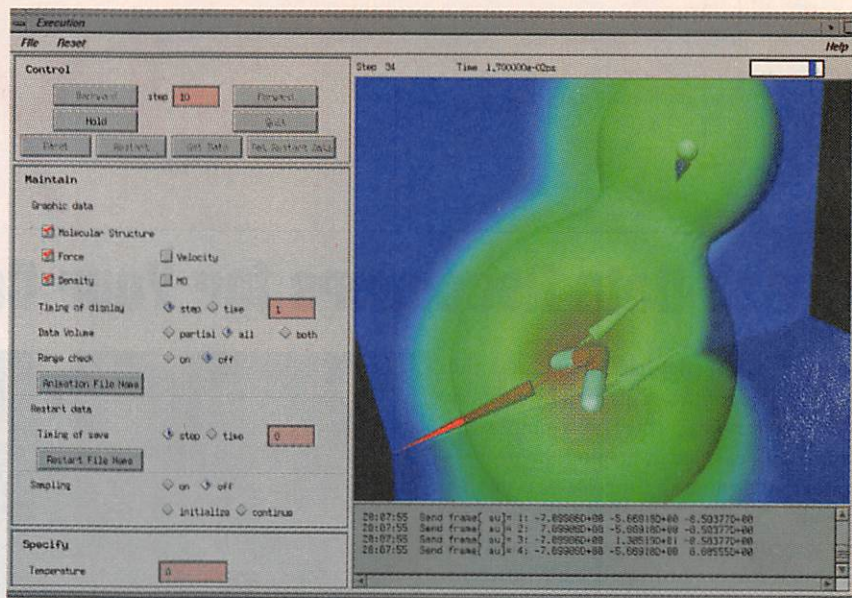
## Virtual Reactions

**T**he development of the virtual microscope is still in the early stages, but NEC's latest computer-simulation technologies have advanced to the point that scientists can "watch" and replay the complex mechanisms of chemical reactions at the atomic and molecular level. A detailed understanding of such mechanisms should make it possible to make existing production methods safer and more efficient.

The virtual microscope is a molecular simulation system that uses a supercomputer to recreate the chemical reaction process—as understood by quantum mechanics—that occurs when molecules collide and displays the process using computer graphics. Chemical reactions occur on the picosecond (one trillionth of a second) scale. The virtual microscope can solve Schrodinger's equations in femtoseconds (one quadrillionth of a second). When one cycle of calculations is completed every  $1/30^{\text{th}}$  of a second and the results are continuously displayed via computer graphics, the chemical reaction process can be portrayed with smooth animation. Because it is an on-line simulation, the scientists' commands, such as degree of rotation and magnification of the graphics, can be processed during the calculation step. Parameters that in a laboratory experiment would correspond to variables such as temperature can also be changed during the simulation.

Where the virtual microscope differs from conventional simulation systems is that when the scientists actively intervene in the simulation, they can observe chemical reactions as if they were watching them through a microscope in the lab. Using a virtual microscope, scientists can watch chemical reactions occurring at slow-motion speeds of 10 to the 14<sup>th</sup> power and magnifications of 10 to the 9<sup>th</sup> power.

Among the benefits of the virtual microscope are that 1) chemical behavior of molecules unseen in the natural world can be observed; 2) simulations can be run to mimic extreme conditions of pressure and temperature; 3) the time scale can be controlled at will—slowing down the reaction, stopping it, or even running it backwards; 4) magnification



THE CONTROL SCREEN FOR NEC's virtual microscope. The settings on the left affect the speed, viewing angle, and other parameters of the atomic-level reaction seen at the right.

and rotation of the graphics display is also possible, meaning that observers can voluntarily change their visual perspective of the reaction; and 5) computer simulations are perfectly safe, with no danger of accidents or mishaps.

With this virtual microscope system, a graphic work station is in charge of the image processing. In the upper left corner of the screen, there are control buttons similar to the pause and rewind buttons on video recorders. Clicking on these buttons makes the simulation stop or back up. The chemical reaction can be seen developing over time on the right side of the screen. While watching the reactions unfold, the viewer's perspective and variables such as temperature can be changed to give a true understanding of the mechanisms involved.—*Courtesy Look Japan*, (November 1998); reprinted with permission

PT

increased concern about the extent of long-term exposure to CRTs. The Fresh BioDisplay CRT (Cathode Ray Tube) from Samsung Display Device (SDD) is a "major breakthrough" in CRT technology values for computer monitors and televisions.

"Fresh BioDisplay is engineered to be environmentally safer than a standard CRT," said Hunsoo Kim, general manager of SDD. This CRT's technology increases the delivery of carefully modulated light waves in the far-infrared portion of the spectrum, strongly reducing stress on the viewer.

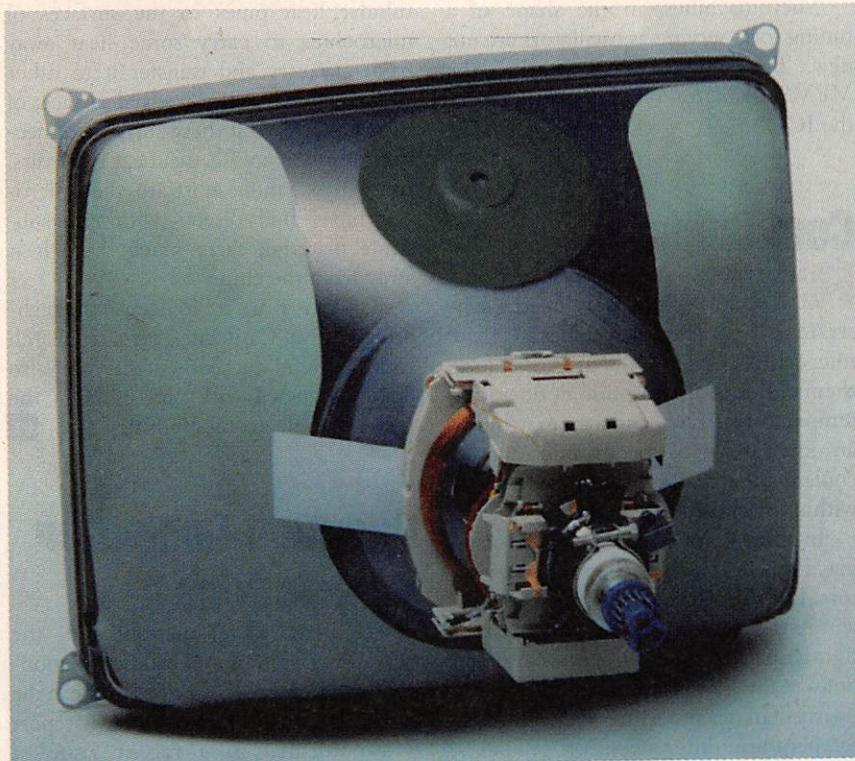
In a study conducted by Dr. Machi Yoshio, a professor at Tokyo Denki University and an expert in the physiological measurements of "subtle energy," subjects who viewed Fresh BioDisplays over long periods displayed a marked reduction of stress. According to Dr. Yoshio, the far-infrared ray (FIR) emissions from these CRTs increased alpha wave production in viewers, a bio-beneficial effect that resulted in less stressful brain wave patterns.

Aside from stress, another concern is the physical impact of CRTs on users. Standard CRTs generate positive ions caused by high voltage and heat, thus breaking the "ion balance." Aging, caused by high-speed heavy ions in dust colliding with the face, is promoted by long-term exposure to electrostatic

## Reduce Stress: Stare at Your Computer Monitor

**W**ith computer users and TV viewers spending increasingly more time in front of the screen on the job and at home, scientists have expressed





A REAR-VIEW of Samsung's Fresh BioDisplay. A ceramic coating on the CRT's funnel increases negative ions, and a variety of techniques have been used to reduce possibly harmful EMF radiation.

fields. According to scientific research, the reduction of electrostatic charges collecting on the surface of the case can slow premature aging of facial skin through the development of a dust-reduction feature.

Fresh BioDisplay's dust-reduction feature—made possible by a special ceramic coating on the CRT funnel—supplies continuous bio-beneficial negative ions that decreases the induced electrostatic charges on the monitor case. Even the manufacturing process reduces electrostatic charges and generates negative ions during the arc discharge. As an example, by “ion-count” measurement,  $4000 \pm 250/\text{cc}$  of negative ions are detected from the Fresh BioDisplay when the negative ions in the atmosphere are only approximately 80/cc.

On the surface of a Fresh BioDisplay 15-inch monitor, dust absorption is reduced by 50%. SDD has also reduced possibly harmful EMF (electromagnetic fields) generated from the deflection yoke by coating the exterior cone with a conductive material and connecting the cone to the external conductive graphite coating and grounding. At the same

time, the CRT's panel is coated with conductive material, and lastly this thin film is connected to the screen with conductive tape. **PT**

## Code Red—Putting The Pieces Together

**A**n earthquake rocks a large modern city, injuring hundreds of people, producing major structural damage, knocking out electrical power, breaking gas mains, and causing an industrial plant to leak toxic chemicals. Collapsed bridges and buildings prevent emergency vehicles from reaching the injured, from attending to dozens of small fires before they become big ones, and from carrying supplies to hospitals and rescue workers.

How do emergency responders and city official cope with the situation? How do they deploy resources where they are most needed? How can they prepare in advance for such disasters, and what can they do to recover from them?

Taking advantage of the Los Alamos

National Laboratory's high-performance computing capability, the Lab's researchers are working on a project to give city officials, regional planners, police, and other agencies a tool to help them plan for and respond to all kinds of disasters. The project, called the Urban Security Initiative, links a wide range of urban subsystems—transportation, energy and water distribution, weather, infrastructure, ecosystems, economic activities, geology, and demographics—into an integrated system that contains all the pieces of the project and combines them into common databases along with geographic information.

“The tools being developed through this project can be used to help deal with natural disasters, environmental problems, the threat of chemical or biological attacks, industrial accidents, and other events,” said geologist Grant Heiken, a member of the Urban Security Team. The project, now in its second year, involves many scientific disciplines, huge amounts of data, dozens of computer programs and tricky interfaces, and numerous collaborations. Heiken likens it to a big jigsaw puzzle being assembled by different groups, with various sections emerging and then needing to be connected properly to make a complete picture.

In addition to improving the responses to emergencies, the project is designed to help prepare for catastrophic events more effectively. “In order for a user community to know how to deal with the immediate aftermath of an earthquake, it would be very helpful to conduct training simulations,” said astrophysicist Eric Jones. “People also want to find out where to locate their resources before a disaster happens to provide the most effective response.”

One collaboration is with the Southern California Earthquake Center and other California agencies on a project to link computer models of seismic ground motion, earthquake-damage predictions, and the infrastructure of the city of Los Angeles to enhance pre-planning and emergency responses. One of the models is of the effects of a major earthquake in the L.A. area.

In addition to collaborating on earthquake modeling in Southern California, the team is working with other cities, federal agencies, and professional orga-



nizations. In one program, they are urging additional studies of urban systems, including a request for a declaration of the years 2001 to 2010 as the "Decade of Science in the Cities." Since almost all growth worldwide is in cities, which are the places most vulnerable to disasters, Heiken believes that "Developing a science-based understanding of their vulnerabilities will help them survive." **PT**

## Seeing Machines in A Grain of Pollen

**J**im Smith, manager of Sandia's Intelligent Micromachine Department—together with researchers Trey Roessig, Al Pisano, and Roger Howe from UC Berkeley—have built a microelectromechanical systems (MEMS) prototype that functions as a clock source. The minuscule machine, with moving parts the size of a pollen grain, performs the same job as quartz crystals.

Micromachines are made from polysilicon—the same material used in manufacturing ICs. Because of this, the micromachines and ICs can be constructed on one chip.

The micromachined clock source, conventional ICs, and other micromachined elements can be built simultaneously to form a complete "system on a chip," Smith says. If mass produced, the chips could dramatically reduce prices and increase reliability.

Hundreds of thousands of the chips can be built on a single silicon wafer. Manufacturing costs would decrease sharply, because assembly would be unnecessary. Currently, quartz-crystal timing devices and ICs are manufactured separately and then assembled.

The MEMS prototype would serve as a replacement clock source. It consists of two very fine strings or tines—ten would fit on a pin head—anchored in parallel to actuator frames the size of red blood cells. The process of building these devices at Sandia appears capable of fabricating integrated oscillators with frequencies above 10 MHz. Despite the high frequencies, these micromachines are producing very low noise. The frequencies provide the constant timing signals necessary for the digital electronics device to operate.

Micromachines, in the shape of a tuning fork, serving as oscillators are not new. The uniqueness is putting the MEMS oscillator on the same chip as the ICs. **PT**

## Cool Chips

**R**esearchers at Sandia National Laboratories have developed a substrate that removes heat from microchips and PC boards, keeping them closer to their optimum operating temperatures. The Sandia approach uses an intricate network of microscopic, coolant-filled passages formed directly within the substrate.

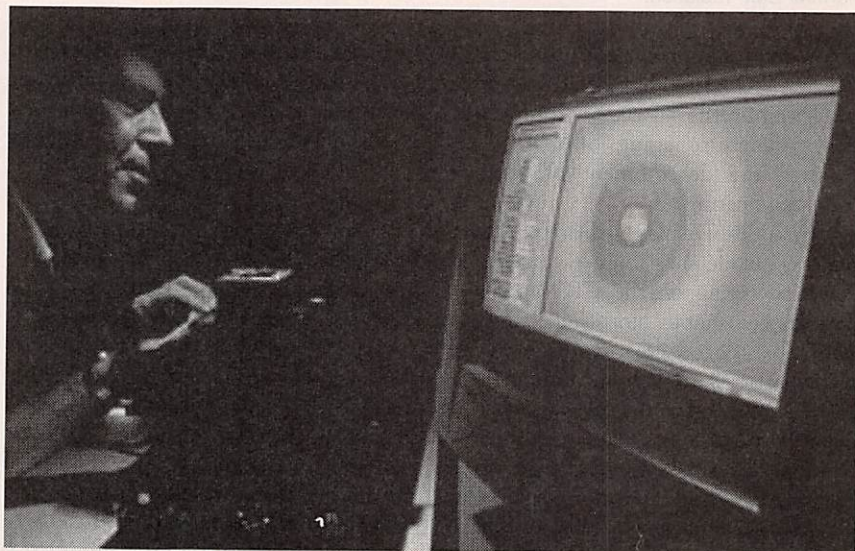
In a few years, a dime-size microchip may house as many as 10 million transistors. But the electrical resistance created within that tiny world even cause today's tightly packed microprocessors to get hot—really hot! Hot microchips and PC boards fail faster. More damaging are temperature differences, or gradients, across chips that can cause tiny cracks and stress voids in the wiring.

tubular heat pipes to the surfaces of microchips to carry some heat away from circuitry and transfer it to other elements, such as the external surfaces of the PC board. But these surface connections are very ineffective heat removers. In the new Sandia substrate, the "micro-heat pipes" built directly within the substrate material, carry much more heat away from the chip.

Sandia is working to license the technology to a California firm. Research and development agreements are also being discussed with end users in the U.S. microelectronics industry. **PT**

## Quantum Computer Calculations

**S**cientists have manipulated the atomic spin of molecules to demonstrate that reliable calculations can be made by a quantum computer. A report was published in a recent issue of *Physical Review Letters* (PRL) on the first experimental use of quantum error cor-



A NEW MICROCHIP SUBSTRATE loaded with built-in "micro-heat pipes" is examined through an infrared thermal imaging microscope.

Various heat-removal methods have been devised for high-end microelectronics but not for everyday electronics devices—because of the cost. As these get smaller and operate hotter, even the most common devices may soon require heat-removal technology.

Manufacturers have added small

rection and on a demonstration of a three-bit quantum computing system.

Working with David Cory at MIT, Los Alamos National Laboratory physicists Raymond Laflamme, Wojciech Zurek, and Emanuel Knill are using nuclear magnetic resonance (NMR) to test their theories. "We have demon-





SHOWN HERE IS A THIMBLEFUL OF 1-Wire chips (actual-size), and in the upper right corner is a chip magnified many times.

strated for the first time that our quantum error correction works as expected. It is also the first time anyone has manipulated three bits in a quantum mechanical way," said Laflamme. "This is the most interesting proof to date that quantum computing is not just a crazy idea."

Unlike today's "classical" computers that make calculations with a binary system of zeroes and ones from digital switches, first-generation quantum computers are assembled from molecular switches called qubits. A qubit can represent one, zero, or potentially any state in between. A functional quantum computer will manipulate atoms to perform many calculations at once by taking advantage of quantum mechanics, which allows qubits to represent many states simultaneously.

"Suddenly you have information encoded on single atoms, and you can do things that you never thought you would be able to do before," said Laflamme. Until recently, the main problem for quantum computing was believed to be an inability to correct errors. Two years ago, the Los Alamos team developed a scheme that uses repetitive processing to reduce the probability of errors. For the general error type, every encoded qubit is checked for errors, corrected, then multiplied five times. Those five qubits also get checked for errors, then corrected and multiplied, etc. Knowing how many steps a particular calculation takes,

the theorists can determine the number of checks needed to ensure the calculation's accuracy.

Now the physicists have adopted NMR techniques for experimenting with qubits. NMR allows scientists to manipulate the atomic spins of nuclei by applying an electromagnetic pulse to molecules diluted in a liquid. The signal is amplified by the molecules acting in parallel. Because the researchers knew the most common errors in NMR were of a specific type, they could test quantum error correction ideas using only a three-qubit system.

Functional quantum computers that exceed current machines are years away. However, these experiments show the hurdles to overcome are merely mechanical—the difficulty of manipulating individual atoms.

PT

## Intelligence Comes in Small Packages

**T**o meet the industry's needs for simplified mounting and reduced size, Dallas Semiconductor's "1-Wire" chips merge bi-directional, digital communication and power into just one signal plus a ground return. Using flip-chip methodology, the wafer-level solder bumping process produces a ready-to use package no bigger than the silicon

chip itself. These silicon-size packages will benefit designers trying to solve board-layout problems.

"It's the lowest-cost way for one chip to talk to another chip," said Michael Bolan, vice-president of product development. "The electron path goes in one bump and out the other. This is in contrast to the higher number of connections needed for traditional chips."

The smallest Chip-Scale Package (CSP) in the industry, these 1-Wire CSPs can be the size of a pin head (as small as 0.77mm × 1.3mm × 0.43mm), yet are as rugged as their larger, plastic-packaged counterparts. Chips in this package range from a simple silicon serial number to devices that include memory and temperature sensors, and all of them attach directly to printed circuit boards with on-chip solder-bump connections.

The solder bump adds just 0.004 inches (0.1mm), an insignificant increase to the 0.77-mm height of the chip. When placed and reflowed on printed board traces, these solder bumps form strong joints. Shear and pull strength tests show that the solder-bump method of board attachment exhibits performance equal to traditional plastic packages. The new 1-Wire CSP packaging passes tests for temperature cycling (1000 cycles of -55°C to +125°C), accelerated operating life, biased moisture, and autoclave.

Manufacturing is simplified as electronic assemblers won't have to retool their automated pick-and-place equipment to place the 1-Wire CSPs on circuit boards; they can use the same equipment that places other components, such as surface-mount chip resistors and capacitors.

"Innumerable everyday things—like printer cartridges, battery packs, medical consumables, and even weather sensors for digitizing the wind—can be more intelligent because the chip can fit into a tight space and survive the use environment," Bolan said. "Often design engineers run out of room as they seek to integrate more and more functionality into ever smaller form factors. Until now, we needed to seal the chip from outside contaminants using a package many times larger than the chip it housed."

For more information, see Dallas Semiconductor's Web site: [www.dalsemi.com](http://www.dalsemi.com).

PT





# LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

## Monitoring Lightning

We have discovered that there was a printer's error in the schematic diagram for the "Storm- Warning Lightning Monitor" (*Electronics Now*, October 1998). The anode of D1 should be connected to the center conductor of J1 along with S2. Figure 1 in the article does not show that connection extending all the way; someone might think (incorrectly) that it should be connected to the outer conductor, grounding the input to IC1.

We apologize for any problems that this misprint might have caused.—*Editor*

## ...and Running Lights

It has come to our attention that the foil pattern that appeared in the article, "Daytime Running Lights for Your Car" (*Electronics Now*, October 1998) had an error. A corrected foil pattern as well as an updated parts-placement diagram (Fig. 1) appears to the right. We regret any inconvenience that might have occurred.—*Editor*

## Input and Information

I am writing about three things that have been mentioned either in editorials or in "Letters" in *Electronics Now*.

First, I like "Prototype." Its coverage of new science and technology, the type of material covered, and the way it is covered make "Prototype" one of the first sections I read in each issue. Second, I like the idea of having a column something like "Try This One" and "Technotes," which were in *Radio Electronics* in the 1950s and 1960s. I had a few items published in those columns at that time, and I already have plans for two short items to submit to the new "Try This One."

Third, there have been several questions about clocks that are self-correcting using radio signals from WWVB. I have just seen a catalog from Klockit (P.O. Box 636, Lake Geneva, WI 53137-0636; Tel:

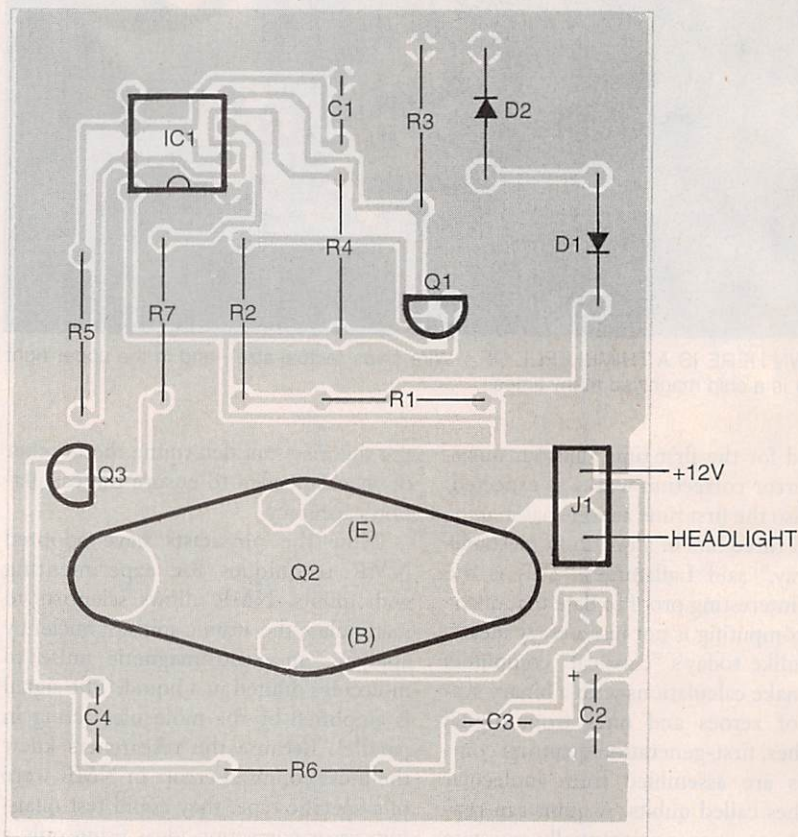
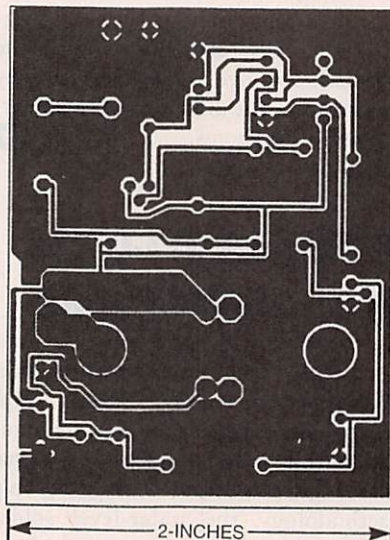


FIG. 1—PARTS-PLACEMENT DIAGRAM for the updated foil pattern



UPDATED FOIL PATTERN

800-556-2548). As their name implies, they sell kits for building clocks. They also sell several types of clock movements or replacements for old movements. Two of their clock kits include a WWVB receiver. Probably of more interest to *Electronics Now* readers are clock movements, powered by one AA cell, which have a WWVB receiver. These sell for \$27.95 plus shipping.

BILL STILES  
Hillsboro, MO

## Airport Chatter

I would like to point out a couple of items not originally mentioned in the article by Anthony Caristi, "The Airport Buddy" (*Electronics Now*, January 1999).



The 108–136-MHz AM aircraft band covers ALL commercial communication, including ground-to-air as well as air-to-air and navigation. The frequencies between 108 and 118 MHz are for navigation, where you will hear mostly VOR guidance beacons, with occasional voice messages from Flight Service Stations (FSS) to help identify a particular beacon. All non-military communications and navigation uses this band, including airlines, cargo haulers, helicopters, and general aviation aircraft (which includes private aircraft). Most ground control frequencies, by the way, are located at the 121-MHz range and will be referred to by the tower as “point 9.”

The other item concerns the usage of this receiver on board the aircraft. It shouldn't be used during a flight for several reasons. First, it is not a device approved by the FAA. Second, because of the lack of an RF preselector, there is probably substantial RF harmonics coming out of the antenna to interfere with aircraft communications and navigation.

P.S. I also have a private pilot's license and a General Class FCC license.  
TODD SESTERO  
Towson, MD

## Letter-Writing Etiquette

Okay, so you've finally completed that really neat project from the latest issue—but it doesn't quite work correctly. Who can help you out? The author is the best person for the job, in all cases. We authors are always eager to help, and indeed, your inquiry lets us know that somebody is actually building this stuff! We sometimes wonder....

Yes, most of us are rather secretive—we don't publish our phone numbers or addresses for a simple reason: privacy! We are, however, easily reached through the publication. Before you even take that approach, consider the following so that you might better expect a reply.

Firstly, do as much troubleshooting on the project as you can. Look for incorrect wiring or wrong values on components. Don't expect the authors to do all the troubleshooting for you. The more information you can provide, the sooner you can expect a solution to your problem. Most requests for help turn out to be builder's construction errors.

Secondly, read the *entire* article once again to make sure that you didn't miss anything.

You have to realize that a project

appearing in the latest issue was probably conceived by the author over a year ago. Yes, it takes that much time to actually prepare everything for publication, both by the author and the publisher. We go to great lengths to publish everything correctly. But, as many people are involved in the process, errors will sometimes creep in. These are normally caught right after publication by the author (or editors) and corrections are noted in future issues and on the publisher's Web site. Try them first.

As most authors write for a living, the article you're inquiring about was probably written about fifty or more articles ago. We tend to get a little hazy after all that time. In order to give an accurate answer, authors have to spend a considerable amount of time in researching the design and refreshing their memory. We do this quite happily. However, time is always in short supply for a writer.

So now you've done all the groundwork, but still haven't had any luck. Now it's time to contact the author. Keep your inquiry brief and to the point. Describe your problem accurately. Above all, be courteous. Here's how to get a prompt response: Send your inquiry along with a self-addressed stamped envelope (S.A.S.E.) to the author, in care of the magazine. I don't know how many inquiries I've received without the S.A.S.E. This usually means an extra delay in responding, especially when the reader is from another country, which requires getting the correct postage.

One of this author's *pet peeves* is someone looking for free design information. I recently received a two-page letter listing over two dozen questions on formulas used for every facet of a complex design. A genuine reply to this type of letter would require writing an entire book. Besides, we actually incorporate a few of our own *trade secrets* in our designs. We don't intend to give these away for free—do you blame us?

Write To:  
Letters,  
Electronics Now Magazine,  
500 Bi-County Blvd.,  
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

If you ever do manage to find an author's address or phone number, or if he chooses to make it public, please be considerate. Typically, a writer's schedule is 24/7—he doesn't have time to chat with you, no matter how nice or how desperate you are. The editors themselves are pretty much in the same boat.

So there you have it—the proper method of contacting an author for help. It's dirt simple, and we're always available to help get the circuit going. We even enjoy it! We value ALL of our readers—don't forget that.

SKIP CAMPISI

EN

## THE COLLECTED WORKS OF MOHAMMED ULLYES FIPS

#166—By Hugo Gernsback.

Here is a collection of 21 April Fools Articles, reprinted from the pages of the magazines they appeared in, as a 74-page, 8½ × 11-inch book. The stories were written between 1933 and 1964. Some of the devices actually exist today. Others are just around the corner. All are fun and almost possible. Stories include the Cordless Radio Iron, The Visi-Talkie, Electronic Razor, 30-Day LP Record, Teleyeglasses and even Electronic Brain Servicing. Get your copy today. Ask for book #166 and include \$9.99 (includes shipping and handling) in the US (First Class), Canada and Overseas (surface mail), and order from CLAGGK Inc., P.O. Box 4099, Farmingdale, NY 11735-0793. Payment in US funds by US bank check or International Money Order. Allow 6-8 weeks for delivery.



MA05

# POPTRONIX®

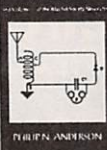
Online  
Edition

We're on the web **FREE**

<http://www.poptronix.com>

## Get your copy of the CRYSTAL SET HANDBOOK

THE CRYSTAL SET  
HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. Claggk Inc., P.O. Box 4099, Farmingdale, NY 11735. USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery.

MA01



# RETAILERS THAT SELL OUR MAGAZINE EVERY MONTH

## California

California Electronics  
221 N. Johnson Ave.  
El Cajon, CA 90202

Ford Electronics  
8431 Commonwealth Ave  
Buena Park, CA 90621

All Electronics  
14928 Oxnard Street  
Van Nuys, CA 91411

Gateway Electronics of CA  
9222 Chesapeake Drive  
San Diego, CA 92123

Mac's Electronics  
191 South "E" Street  
San Bernardino, CA 92401

Electronics Warehouse  
2691 Main Street  
Riverside, CA 92501

Orvac Electronics  
1645 E Orangethorpe Ave.  
Fullerton, CA 92631

Sav-On Electronics  
13225 Harbor Blvd.  
Garden Grove, CA 92643

JK Electronics  
6395 Westminster Blvd.  
Westminster, CA 92683

Kandarian Electronics  
1101 19th Street  
Bakersfield, CA 93301

Whitcomm Electronics  
105 W. Dakota #106  
Clovis, CA 93612

Minuteman Electronics  
37111 Post St., Suite 1  
Fremont, CA 94536

HCS Electronics  
6819 S. Redwood Drive  
Cotati, CA 94931

Halted Specialties Co.  
3500 Ryder Street  
Santa Clara, CA 95051

Metro Electronics  
1831 J Street  
Sacramento, CA 95814

HSC Electronics  
4837 Amber Lane  
Sacramento, CA 95841

## Colorado

Gateway Electronics of CO  
2525 Federal Blvd.  
Denver, CO 80211

Centennial Electronics  
2324 E. Bijou  
Colorado Sps., CO 80909

## Connecticut

Cables & Connectors  
2198 Berlin Turnpike  
Newington, CT 06111

Electronic Service Prod.  
437 Washington Avenue  
North Haven, CT 06473

## Florida

P. Benavides Corp.  
3900 NW 79 Ave. Suite 600  
Miami, FL 33166

## Georgia

Normans Electronics Inc.  
3653 Clairmont Road  
Chamblee, GA 30341

## Illinois

Tri State Elex  
200 W. Northwest Hwy.  
Mt. Prospect, IL 60056

## Maryland

Mark Elec. Supply Inc.  
5015 Herzel Place  
Beltsville, MD 20705

Amateur Radio Center  
1117 West 36th Street  
Baltimore, MD 21211

## Massachusetts

U-Do-It Electronics  
40 Franklin Street  
Needham, MA 02194

## Michigan

Purchase Radio Supply  
327 East Hoover Avenue  
Ann Arbor, MI 48104

Norwest Electronics  
33760 Plymouth Rd.  
Livonia, MI 48150

The Elec. Connection  
37387 Ford Road  
Westland, MI 48185

Elec. Parts Specialists  
711 Kelso Street  
Flint, MI 48506

## Minnesota

Acme Electronics  
224 Washington Avenue N.  
Minneapolis, MN 55401

## Missouri

Gateway Electronics of MO  
8123-25 Page Blvd.  
St. Louis, MO 63130

## New Jersey

Lashen Electronics Inc.  
21 Broadway  
Denville, NJ 07834

## New York

LNL Distributing Corp.  
235 Robbins Lane  
Syosset, NY 11791

Unicorn Electronics  
Valley Plaza  
Johnson City, NY 13790

## Ohio

Philcap Electronic Suppliers  
275 E. Market Street  
Akron, OH 44308

## Oregon

Norvac Electronics  
7940 SW Nimbus Avenue  
Beaverton, OR 97005

## Texas

Tanner Electronics  
1301 W Beltline  
Carrollton, TX 75006

Mouser Electronics  
958 N. Main Street  
Mansfield, TX 76063

Electronic Parts Outlet  
3753 B Fondren  
Houston, TX 77063

Computers Electronics Etc.  
110 E. Medical Center Blvd.  
Webster, TX 77598

**If you'd like to sell our magazine in your store,  
please circle 210 on free information card  
or  
Contact Gina Gallo at (516) 293-3000 ext 223**



# BUILD A Surface-Mount Shortwave Radio

*Build this radio using either surface-mount components, through-hole components, or a mix of the two—the choice is yours.*

PAUL YOST

Like many other professionals in the electronics field, electronics instructors must keep current with the latest technical changes and products. As technology advances, the skills and knowledge of the technician must advance as well. Therefore, it is often a challenge to develop new classroom projects that demonstrate such advances.

The focus for many new designs is to make the product smaller, lighter, and faster. Because of that, surface-mount devices (SMDs) have rapidly replaced the older traditional through-hole components in many products. Therefore, students (as well as established electronics professionals) should learn about those devices as well. However, demonstration is not enough. To truly educate, the project must be just as interesting as it is educational—nothing is less instructional than a boring project. Fortunately, the Surface-Mount Shortwave Radio presented here combines learning with entertainment by introducing the builder to the fascinating world of shortwave listening.

Although the Surface-Mount Shortwave Radio is a well-designed shortwave receiver, its main purpose is to educate. In many ways, it is a self-contained semiconductor course and lab exercise. During its construction, we will be working with (and learning about) Field-Effect Transistor (FET) circuits, oscillators, operational amplifiers, varactor diodes, L-C circuits, Zener diodes, ceramic filters, bipolar transistors, power amplifiers, specialized IC circuits, and modern surface-mount devices. Yet, what truly makes the Surface-Mount Shortwave Radio

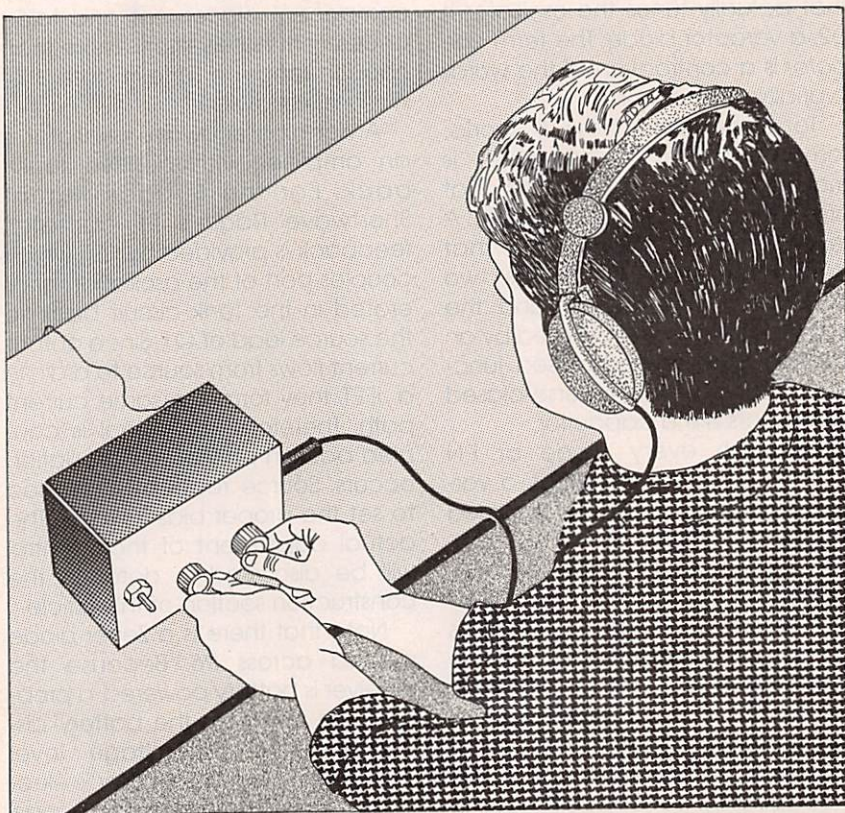
project unique is its construction versatility. The board design works with either standard components or their surface-mount equivalents. The builder has the option to use either type or both in any combination on the board. That means that you can practice with SMDs as much—or as little—as you want.

**Theory of Operation.** The Surface-Mount Shortwave Radio is a superheterodyne receiver with varactor tuning. It operates in the high-frequency (HF) band and is capable of receiving shortwave broadcasts from around the world. On a good night, stations from Africa, Australia, Europe, Asia, and South America

can often be heard.

The circuit's block diagram is shown in Fig. 1. It consists of seven main sections: the tuning oscillator, the RF amplifier/mixer, the IF filter, the IF amplifier/detector, the audio preamplifier, the audio power driver, and the voltage regulator. Figure 2 shows the schematic for the circuit. Follow along with those diagrams as we discuss each section in turn.

**The Tuning Oscillator.** The heart of any good superheterodyne receiver is its tuning oscillator. While that circuit mainly determines the frequency range of operation, it can also affect the sensitivity and clarity





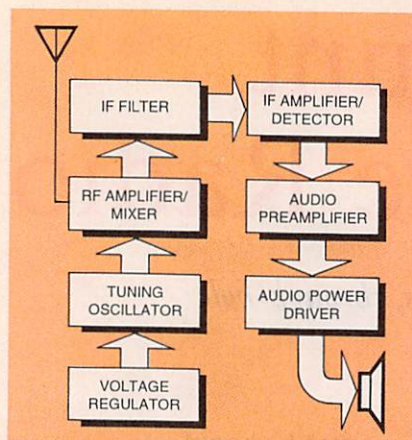


Fig. 1. When reduced to basics, the Surface-Mount Shortwave Radio is simply a superhetrodyne AM receiver that can pick up stations that broadcast on frequencies as high as 17 MHz.

of the station being heard. A properly designed and functioning oscillator is therefore critical for proper operation of the entire receiver. For the Surface-Mount Shortwave Radio, the oscillator section is built around Q1, an MPF102 general-purpose N-channel JFET (Junction Field-Effect Transistor). The tuned part of the circuit is a parallel-resonant LC "tank" circuit, located on the drain lead of Q1. The tank circuit is made up of L1, C8, and D2; those components set the frequency of operation. The part that actually tunes the oscillator is D2, a varactor diode. The term *varactor* is a contraction of the words "variable capacitor."

To understand how it works, remember that a capacitor is made from two conductors that are separated by an insulator. A reverse-biased diode fits that description because it has two conductors (the anode and the cathode) that are separated by an insulator (the reverse-biased junction). That is why a reverse-biased diode acts like a capacitor.

Although every diode or PN junction exhibits that effect, a varactor diode is specifically designed to take advantage of it. In our oscillator, the varactor's cathode is connected to the positive power supply through L1 while its anode is connected to a variable voltage source from R6. As R6 is adjusted, the amount of reverse bias applied to D2 is varied. That, in turn, varies the size of D2's depletion zone and, consequently, its capacitance. In

our tank circuit, D2 can be varied from 30 to 90 pF.

The frequency of an LC circuit is determined by the formula:

$$FR = 1/(2\sqrt{LC})$$

where FR is the resonant frequency in Hz, L is the inductance value in henries, and C is the capacitance value in farads. In our circuit, the C value is the combination of C8 and D2. However, the capacitance value of C8 is far larger than that of D2 and, because the smaller value rules when capacitances are in series, the total capacitance effectively equals that of the varactor alone. Therefore, we can calculate the operating range of the oscillator by using the upper and lower values of D2's capacitance range (30 to 90 pF) along with the 3.3 microhenry inductor value of L1. Doing the math (which is straightforward and left as an exercise for interested readers) reveals that:  $FR_{MIN} = 9.235$  MHz and  $FR_{MAX} = 15.95$  MHz.

Theoretically, the oscillator should operate between 9.2 and 16 MHz, but it usually tunes an approximate 5-MHz range somewhere between 7 and 17 MHz. That is caused by component placement and tolerances. Fortunately, that is more than enough range to tune in dozens of stations worldwide.

An analog sinewave oscillator is an amplifier with positive feedback. For the Surface-Mount Shortwave Radio's RF oscillator, feedback is provided by C7, which couples part of the oscillation generated in the tank circuit back to the source lead of Q1. Since output current flows from source to drain in a JFET, they form the same current path. Therefore, the signal is coupled back in phase and oscillation occurs. Source resistor R13 is used to set the proper bias voltage. The actual adjustment of that control will be discussed in detail in the construction section of this article.

Note that there is a Zener diode placed across R6. Because the receiver is battery powered, a problem can occur as the battery discharges and its voltage level declines. Since the oscillator is electrically tuned, any voltage change

## PARTS LIST FOR THE SURFACE-MOUNT SHORTWAVE RADIO

### SEMICONDUCTORS

- IC1—NE602A or SA602N RF/IF mixer, integrated circuit, see text
- IC2—Not used
- IC3—LM741 op-amp, integrated circuit
- Q1—MPF102 N-channel field-effect transistor
- Q2—2N4401 NPN transistor
- Q3—2N3904 NPN transistor
- D1—1N4738 8.2-volt Zener diode
- D2—MV2209 varactor diode

### RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)

- R1—470-ohm
- R2—15,000-ohm
- R3, R8—R11—1000-ohm
- R4—220,000-ohm
- R5—10-ohm
- R6, R7—50,000-ohm potentiometer
- R12—Not used
- R13, R14—10,000-ohm potentiometer

### CAPACITORS

- C1, C4, C5—100-pF, ceramic-disc
- C2, C6, C7—47-pF, ceramic-disc
- C3, C8—0.001-μF, ceramic-disc
- C9—0.01-μF, ceramic-disc
- C10—Not used
- C11, C12—1-μF, 25-WVDC, electrolytic
- C13, C14—10-μF, 25-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

- ANT1—Whip or wire antenna (see text)
- B1—9-volt battery
- FL1—4.5-MHz ceramic filter
- J1—1/8-inch headphone jack
- L1—3.3-μH coil
- L2—1-mH coil
- S1—Single-pole, single-throw switch
- 9-volt battery clip, case, hardware, etc.

**Note:** The following items are available from Paul E. Yost, PO Box 32291, Louisville, KY 40232: Complete kit of parts with all the parts listed above including both surface-mount and through-hole components, \$24.95 plus \$1.25 shipping; Blank PC board, \$11.95 plus \$1.00 shipping. Kentucky residents must include 6% sales tax. No credit card, C.O.D., or orders outside of the USA or Canada will be accepted.

to D2 will cause a corresponding shift in frequency. The battery voltage for D2 is regulated by D1 to help maintain a steady voltage level in order to minimize that effect.



# 1 Study at Home

We live in a constantly changing world, where exciting new technological advancements are made everyday. At the Cleveland Institute of Electronics we make it simple to train, earn a degree and prosper in the workforce. Over 150,000 students in the United States and 70 foreign countries got their start in electronics through CIE. And they received their education at their own pace in the comfort and convenience of their homes. At CIE you'll receive a first class education by a faculty and staff devoted to your career advancement. All of CIE course and degree programs are taught through a patented, proven learning process. To discover all the benefits and programs/degrees available from CIE send for your free course catalog today.



CIE's Associate Degree program contains 397 lab experiments.

# 2 Work Where You Want

And once you complete your education at CIE, you can just about write your own ticket to where you want to work and in what specialized field... MIS, broadcasting, industrial, automotive, management... The opportunities seem limitless in today's high-tech world.

The Cleveland Institute of Electronics has been approved for use of Veterans Affairs Benefits and DANTES Tuition Reimbursement.

Tuition assistance from the Veterans Administration or the DANTES Program is available to veterans and service members in the Armed Forces.



Employees are seeking & hiring qualified applicants.

## FREE CATALOG



1776 E. 17th Street  
Cleveland, Ohio 44114-3679

Visit Our Web-Site  
[www.cie-wc.edu](http://www.cie-wc.edu)

☐ **YES!** I am interested.  
Please send me a catalog.

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Phone Number: \_\_\_\_\_

*A school of thousands. A class of one. Since 1934.*

**AE140**



**The RF Amplifier/Mixer.** This section is built around IC1, an NE602 /SA602 chip. Although the NE602 is no longer being manufactured, it is still available from several sources including JDR Microdevices, 1850 South 10<sup>th</sup> St. San Jose, CA 95112 Tel: 800-538-5000. That chip also comes as part of a kit available from the supplier provided in the Parts List. The SA602, A drop-in replacement, is currently being manufactured.

The NE602 is an IC that has been specifically designed as an RF amplifier and mixer. It first amplifies the weak incoming radio signal on pin 1 and then mixes or "heterodynes" it with the oscillator output coupled to pin 6 through C6. Both signals are sinewaves; whenever two sinewaves mix, four signals result. Besides the two original signals, two new signals are formed at the sum and difference frequencies of the originals. For example, if a 7-MHz signal is mixed with an 11.5-MHz signal, two new sinewaves

would occur at 18.5 MHz (the sum) and 4.5 MHz (the difference). As we will see, the difference signal will be used to select the desired station.

**The IF Filter.** Two important receiver characteristics are *sensitivity* and *selectivity*. Sensitivity is the ability to receive weak or distant stations; selectivity is the ability to receive only the station you want despite the presence of other, possibly stronger, stations. Sensitivity is obtained by proper antenna connection and RF amplification. Selectivity is obtained by the use of FL1, a special filter that is located just after the mixer stage. That filter is known as the IF filter; the letters "IF" stand for *Intermediate Frequency*. For most receivers, the IF signal is the difference frequency created by the mixer circuit. It is called the intermediate frequency because it is a middle- or intermediate-frequency signal that is between the higher frequency of the RF input and the lower frequen-

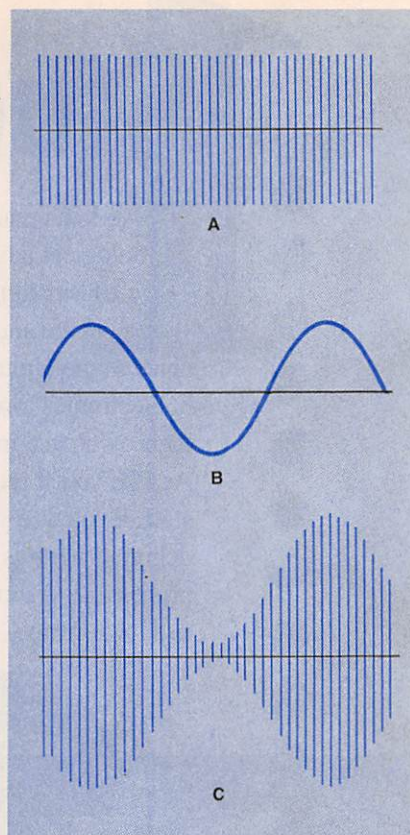
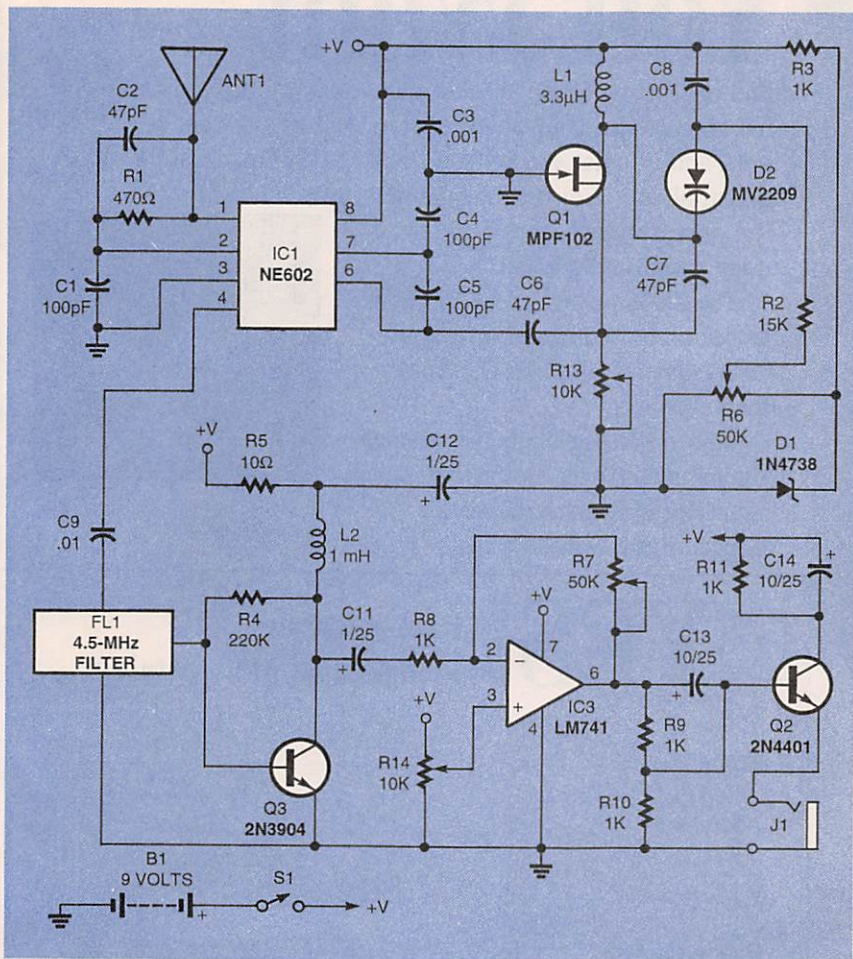


Fig. 3. To create an AM-broadcast signal, you take a carrier at the frequency that you want to broadcast on (A) and modulate it with an audio signal (B). The combined signal is a carrier wave that fluctuates at the rate of the audio signal (C).

cy of the audio output. The Surface-Mount Shortwave Radio uses 4.5 MHz as the IF frequency. It was chosen because 4.5 MHz is a very common and inexpensive filter to obtain. Two other common IF frequencies are 455 kHz and 10.7 MHz—some radio designs use those values instead.

Tuning a radio receiver is quite simple. Although many stations broadcast simultaneously throughout the world, only a station on a frequency that is *exactly* 4.5 MHz away from the oscillator signal will be heard. That occurs because only 4.5 MHz can pass through the IF filter. An example of that effect is the mixing that would occur for the shortwave stations of the BBC in England and *Radio Nacional* in Ecuador. Those two stations broadcast at 9.825 MHz and 9.745 MHz respectively. To receive the BBC, the oscillator could be tuned to 14.325 MHz. When the two signals mix inside IC1, the resulting difference frequency is 4.5 MHz (14.325 MHz -





9.825 MHz = 4.5 MHz). That signal would then pass through FL1 for processing by the rest of the receiver; the result is that the BBC broadcast would be heard. By contrast, the *Radio Nacional* signal would not be heard because its difference frequency would be 4.58 MHz, which is much too high to pass through the filter.

It should be apparent by now

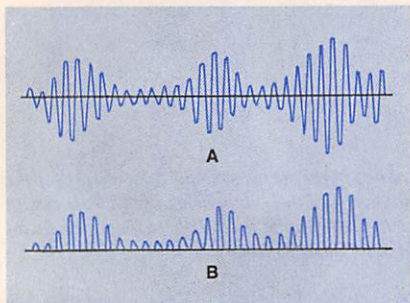


Fig. 4. When an audio signal (A) is half-wave rectified, the resulting signal (B), while odd looking, is nonetheless very usable in recreating the station's audio signal.

that the oscillator/mixer/filter combination of circuits makes selective tuning possible. However, that tuning method does create a potential problem. Occasionally, two separate stations can each be located 4.5 MHz away from the oscillator frequency. For example, while the BBC broadcasts at 9.825 MHz (4.5 MHz below), another station could also be transmitting at 18.825 MHz (4.5 MHz above)—both of which are exactly 4.5 MHz away from the 14.325 MHz oscillator signal. In that case, the radio would try to receive both stations simultaneously. Not surprisingly, that would cause a tremendous interference and neither station would be heard clearly.

That phenomenon is called the

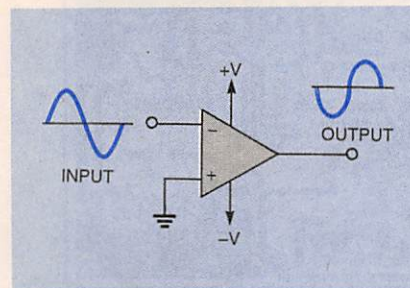


Fig. 5. When a ground-referenced audio signal is applied to the inverting input of an op-amp, the output signal is an exact mirror image of the original signal. Even though the output signal is 180° out of phase with the input signal, our ears can't tell the difference between the two unless we hear them side by side.

*image frequency effect*. The unwanted station is called the image because it is like an image one would see in a mirror—the exact same distance away from the mirror as the original but on the opposite side. Yet despite that potential problem, the heterodyning or IF system is still an excellent and efficient way to make a good, selective receiver.

**The IF Amplifier.** Although radio transmitters often use thousands of watts of power to broadcast, the signal is typically just a few microvolts in strength by the time it reaches the receiver. That is due for the most part to the long distance that the signal must travel—sometimes thousands of miles! While the signal level is increased by the RF-amplifier circuit, it is still only a few millivolts in amplitude by the time it exits the IF filter—a level far too weak to properly drive a detector circuit. Additional amplification is required. That amplification is done by Q3, a 2N3904 transistor.

**The Detector.** Shortwave stations broadcast in the High Frequency or “HF” band and use amplitude modulation (AM). The actual radio signal is called the *carrier* while the music or voice part is called the *intelligence* or *modulating* signal. Some texts also refer to that as the *baseband* signal. For AM systems, the audio actually rides the amplitude of the carrier wave. That is, the audio signal changes or modifies the amplitude of the carrier. The process is shown in Fig. 3. If you looked at a straight RF signal on an oscilloscope, it would look similar to the waveform shown in Fig. 3A. If an audio-frequency signal such as the one shown in Fig. 3B is used to amplitude modulate the RF signal, the result would be the signal shown in Fig. 3C.

Radio theory is a very broad subject area and is beyond the scope of this article. For our purposes, it is only important to know that a signal resembling the waveform in Fig. 3C will be present at the output of FL1 when you receive a station. That signal is amplified by Q3.

The modulated signal has two features that should be noted—it is

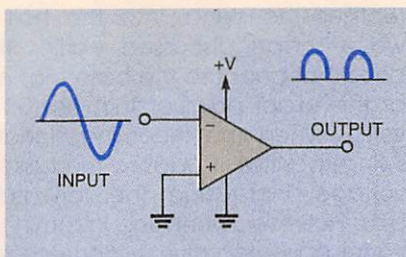


Fig. 6. If we try to feed a ground-referenced audio signal into an op-amp that does not have a negative-voltage source, the result is a half-wave rectified output that will sound terrible. What is needed is to change the reference level of the audio signal so that it is at half of the power-supply voltage.

an AC signal with both a negative- and positive-going peak, and it is symmetrical. With the modulating signal appearing on both halves of the carrier, only one half of the signal is needed to recover the audio signal.

Transistor Q3 also functions as the demodulator stage. Besides providing amplification, Q3 also rectifies the carrier signal of Fig. 4A into the half-wave shape shown in Fig. 4B. The action is similar to the rectifier method used in a power supply. That happens because Q3 uses only a single resistor (R4) to provide the base bias. Because the emitter lead connects straight to ground, the voltage across the emitter-base junction is the standard 0.7-volt drop of a silicon PN junction. That places the transistor right at the point of conduction, making it extremely sensitive to the slightest voltage change on the base.

Having Q3 biased just above ground serves two purposes. First, it creates the maximum gain possible for low-signal conditions. Second, it

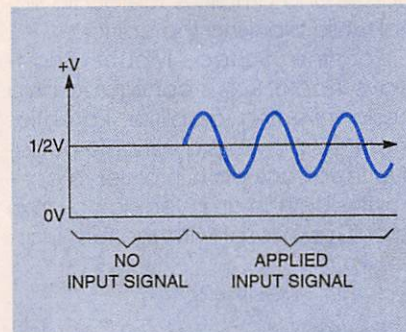


Fig. 7. When an audio signal is referenced at a voltage level above ground, amplifiers that have no negative-voltage source will be able to amplify the signal without clipping the negative-going parts of the waveform. The result is a clean-sounding signal that is not clipped.



rectifies the signal into the half-wave shape discussed earlier. It does that because the base bias is at the exact point of turn on (0.7 volts). When the incoming signal swings positive, it adds to the base voltage, increasing the forward bias. However, when the incoming signal goes negative, it decreases the base bias to a point below the conduction level, turning off Q3. The result is the rectified signal that is needed to complete the demodulation process.

Two signals are present in the resulting waveform—the carrier wave and the modulating wave. The modulation wave, being audio, typically varies between 50 and 5000 Hz, but some stations now broadcast a wider range (up to 15 kHz) to provide a high-fidelity service similar to the American FM broadcast system. The two signals must be separated so that only the audio signal passes through to the output. That is done by the audio preamp circuit, which will be discussed next.

**The Audio Preamp.** The rectified half-wave audio signal and 4.5-MHz carrier that appear across L2 are passed to IC3 through coupling capacitor C11. Integrated circuit IC3 is a 741-type op-amp. Being an early example of an IC amplifier, IC3 is severely frequency limited. In fact, it is specifically designed to provide no gain for signals above 1 MHz, so it cannot pass the 4.5-MHz carrier signal. However, for lower-frequency signals (like audio), the 741 can provide a gain as high as 100 or more. That is how the audio gets separated from the carrier. The op-amp passes and amplifies the audio signal while blocking the carrier.

For the Surface-Mount Shortwave Radio, IC3 is configured as a basic inverting amplifier. Potentiometer R7 provides a variable negative feedback path in order to control the gain. In an inverting op-amp circuit, gain is set with the formula:

$$\text{Gain} = R_F / R_{IN}$$

where  $R_F$  is the feedback resistance and  $R_{IN}$  is the input resistance.

Let's apply that formula to find the gain of our op-amp circuit. In the circuit, R7, with a variable range

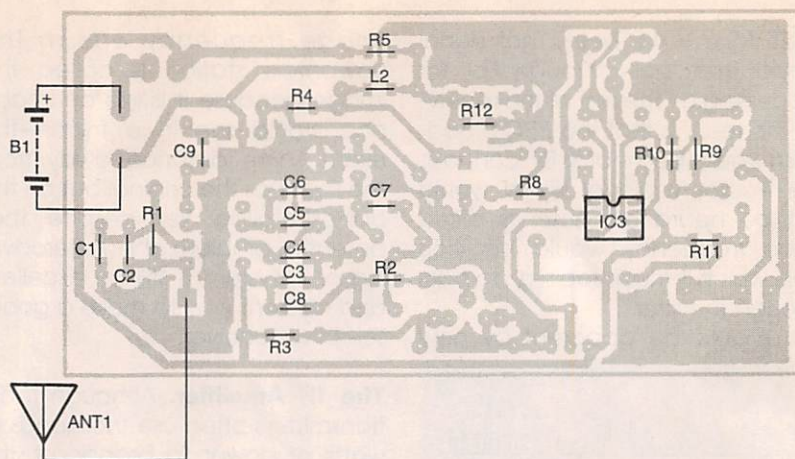


Fig. 8. This parts-placement diagram shows the locations of the surface-mount components for the Surface-Mount Shortwave Radio. Although most (if not all) of the components used in the circuit are available in surface-mount form, some items are too bulky to be used. Other components cannot be used because of constraints in the routing of the PC board's traces.

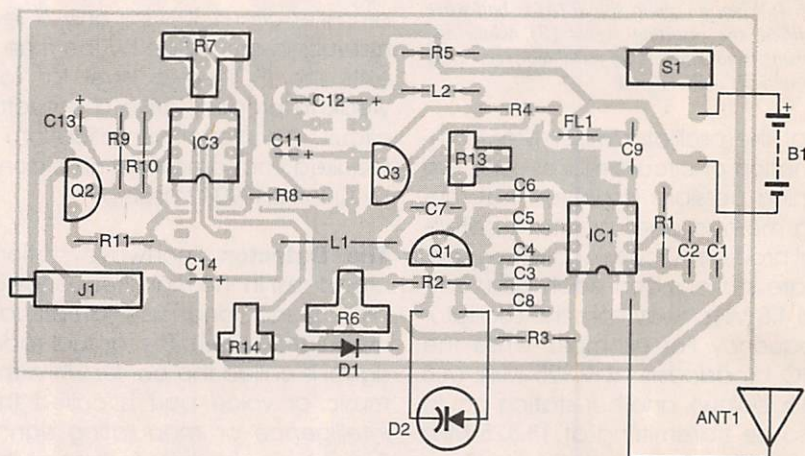
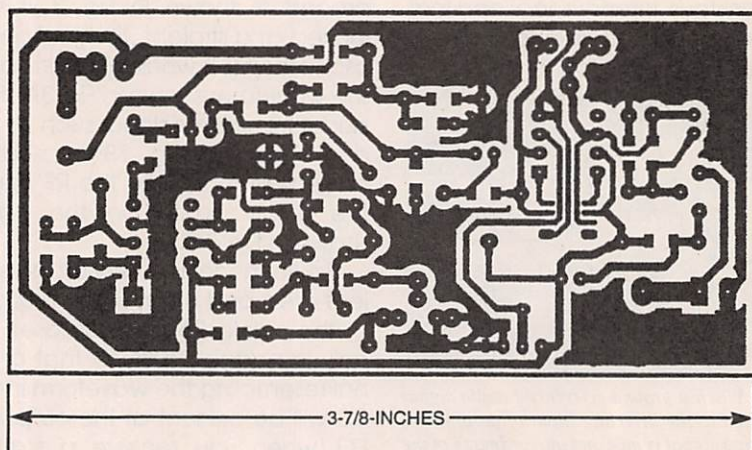


Fig. 9. Follow this parts-placement diagram for locating the through-hole components of the Surface-Mount Shortwave Radio. Remember, if you've used a surface-mount device for a particular component, do not use the through-hole part as well—only one of each type is needed.



Here's the foil pattern for the Surface-Mount Shortwave Radio. Despite using two widely-divergent technologies (surface-mount and through-hole), the entire unit can be built on a single-sided board.



## HELPFUL CONSTRUCTION TIPS

Be sure to observe the polarity markings when installing an electrolytic capacitor.

Observe proper IC placement. Pin 1 is marked by either a dot or a notch on the chip.

If you use insertion-mount devices, the disk capacitors, transistors, and the varactor should be mounted above the board with some lead length showing. The other components should be mounted flush to the board with excess lead lengths clipped off.

Refer to the schematic diagram and parts-placement diagrams often in order to make sure that your construction is correct. Since this project is a relatively low-frequency device, actual parts positioning and lead lengths aren't critical but neatness should always be a primary concern.

Use good soldering practices during construction. Before soldering a joint, wipe the soldering iron tip clean on a wet sponge. Melt a small ball of solder on the iron tip. Touch that molten solder to the joint to be soldered first. The liquid solder forms a "heat bridge" that lets the joint area heat up to melting temperature quickly before the heat flows away to the surrounding area. Let the soldering tip heat each component lead and board trace just enough to make the solder flow smoothly. Although most of the parts used in this project are not overly heat sensitive, the copper pads and traces on the PC board can lift up if they are allowed to get too hot.

Mark off each part on the list as you install it. That will help keep track of your work.

of zero to 50,000 ohms, is  $R_F$ ; and  $R_8$ , at 1000 ohms, is  $R_{IN}$ . Plugging those values into the formula, we see that the maximum gain is 50 (50,000/1000) and that the minimum gain is zero (0/1000). It is easy to see that  $R_7$  can be used as the Surface-Mount Shortwave Radio's volume control.

Another feature of the audio pre-amplifier circuit is that it also provides the bias voltage that drives Q2, the audio output. An op-amp normally requires a dual-polarity power supply to operate. That lets the output signal swing both positive and negative across the ground reference. Unfortunately, dual-polarity supplies are both expensive and inconvenient to use—especially with battery-operated devices. Fortunately, op-amp circuits can be made to operate from a single supply by placing a DC offset voltage on one of its inputs.

An op-amp is a differential amplifier that has two inputs and one output. One of the inputs is "inverting" while the other is "noninverting." A signal applied to the inverting input will be phase shifted 180 degrees (or inverted) at the output. By contrast, a signal applied

to the noninverting input will remain unchanged in phase at the output. If two signals are simultaneously applied to both inputs, their difference appears at the output multiplied by the gain of the circuit. Normally, only one of the inputs is used for the signal; the other is referenced to ground. A simplified example of that type of circuit is shown in Fig. 5. Since the unused input is grounded, it effectively stays at zero volts. Therefore, the difference between the two inputs automatically becomes the incoming signal, which is then amplified and passed through to the output. That circuit works fine when both a negative and positive supply are available. What would happen if only a positive supply is available?

In that case, the output signal could only swing positive as shown in Fig. 6. For the op-amp to work from a single supply voltage, the circuit must be able to produce both positive- and negative-going signal swings. The easiest way to do that is to offset the output reference above ground. That is done by referencing the unused input to one-half of the positive supply voltage instead of connecting it to

ground as we've done with IC3. The bias voltage is supplied by  $R_{14}$ . That will let the output signal swing both positive and negative around the bias level. The resulting waveform on an oscilloscope will look like the waveform shown in Fig. 7.

The output signal has effectively become an AC signal that is riding on top of a DC level. Normally, the DC component is removed before the signal passes on to the next stage (usually by coupling capacitor) but, in this project, we do not remove it. Instead, it is used to bias Q2, the audio power amplifier.

### The Audio Power Amplifier.

Transistor Q2 is the main component of the audio-output stage. Note that it is wired as a common-collector amplifier. That type of circuit was chosen because its low-impedance output allows a direct connection to a headset. Like all bipolar transistors, Q2 requires a certain amount of DC bias in order to operate. Often, a resistor divider network is used to provide bias; our circuit is no exception. Resistors  $R_9$  and  $R_{10}$  form the bias network for Q2. Normally, most amplifiers connect the bias resistors to the power supply. We will not be doing that here because the DC offset from IC3 is providing the bias.

Capacitors C13 and C14 are bypass capacitors that block any DC while passing the AC audio signal. They create a low-impedance audio-signal path around the bias-resistor network, increasing gain. From here, the signal goes on to drive the headset.

**Construction.** Building the Surface-Mount Shortwave Radio is as simple as mounting the parts to a printed-circuit board; no particular order is required. A foil pattern for a single-sided board has been included here. As an alternative, a pre-etched board is available from the source given in the Parts List. If you purchase a board or make one from the foil pattern, the parts-placement diagrams in Figs. 8 and 9 indicate where the various components should be mounted. Remember that you can use either surface-mount or through-hole components—the option is yours.



If you decide to use surface-mount components, you should place those items on the board first. Figure 8 is specifically for the surface-mount components. For those unfamiliar with the techniques involved, several sidebars on working with SMTs well as information related to them can be found elsewhere in this article. The Glue-Place-Solder method that is demonstrated is probably the best method to use when assembling the Surface-Mount Shortwave Radio. Please keep in mind that this project is "component versatile." If you have trouble in placing an SMD part, you can simply substitute the through-mount device instead; the PC board will accept either type. When deciding whether to use surface-mount or traditional components, remember that you can use as many or as few of the surface-mount components as you want. The receiver works just as well with either type of device installed on the board.

The most important thing to remember when building this project is that either a surface-mount or a through-hole component should be used for a particular component. **DO NOT** place both types on the board for the same reference designation.

One last note: While surface-mount components could be used for all parts, in a few instances using standard through-hole components is recommended. Those are C6 (because of a ground trace that the component would have to straddle, increasing the likelihood of a short) and C11-C14 (due to their size).

Figure 9 is the parts-placement diagram for any insertion-mount components you elect to use. None of the parts are particularly sensitive or difficult to mount. Neither S1 nor FL1 are polarity sensitive; you can install them in either direction on the board.

When all of the parts are installed on the board, the basic construction of the unit is complete. Only one more item is necessary for receiver operation—the antenna. The most convenient type to use is a straight piece of wire. The antenna wire should be 18 to 24

## HELPFUL HINTS FOR INSTALLING SMDs

Because of their small size, surface-mount devices (SMDs) are easy to lose. When working with SMDs, you should place and keep all parts on a plain sheet of white paper.

Before you glue or place any parts, you need to clean the PC board. You can do that by using alcohol or some other non-residue cleaning solution specifically made to safely clean electronic equipment. **DO THAT EVEN IF THE BOARD APPEARS TO BE FINE.** If you do not clean the board first, then some of the solder connections that you make during construction might become intermittent and cause improper operation that will be difficult to trace.

Do your best to keep the glue between the trace runs and off the pads.

After you place the part on the board, you should allow the glue to dry first. That will prevent the part from shifting during the soldering process.

For easy soldering, smear some soldering paste (such as RadioShack 64-021) on the pads and terminal ends of the SMD after it has been glued in place. Also, you should use the smallest diameter solder available. For example, RadioShack 64-005 solder is only 0.032 inches in diameter.

None of the SMD resistors or capacitors used in the Surface-Mount Shortwave Radio are polarity sensitive. You may place them either way on the board.

**DO NOT** use a soldering iron larger than 25 watts and use the finest point possible. You should also have a good set of tweezers, a magnifying glass, and some desoldering wick when working on this project.

gauge with a length between 25 and 50 feet. One end of the wire connects to the PC board at the hole marked "ANT1" on the parts-placement diagrams. The rest of the wire should be stretched out full length away from the radio.

The Surface-Mount Shortwave Radio can be mounted in any suitable case. After checking over your work for errors such as bad solder joints, solder bridges or incorrect or backward-mounted components, you can test the unit.

**Testing and Adjustment.** The Surface-Mount Shortwave Radio is designed to operate from a standard 9-volt battery. Apply power to the radio but **DO NOT** connect a pair of headphones to J1 yet—that will be done later.

The first step is to set the oscillator bias. Set both R6 and R12 to their center range and connect an oscilloscope to Q1's source lead. It is very important to use a 10X probe; any other type of probe will load the circuit and kill the signal. Adjust R12 until you see a sine wave on the oscilloscope that is a good compromise between signal ampli-

tude and symmetrical shape. You need to check the signal across the entire oscillator range, though, so vary R6 (the tuning control) from end to end and readjust R12 as needed to compensate for any distortions that might occur. When the circuit is working properly, the oscillator signal will vary a few megahertz in frequency—somewhere between 7 and 17 MHz.

If the oscillator does not work, check for 9 volts on the drain lead of Q1. If that is missing, check to see if L1 is open, S1 is defective, or for a defective battery clip. If the voltage on the drain is correct, then check the voltage level on the anode of D2. That voltage should vary between zero and 8.2 volts as you turn R6. If you do not obtain those results, then either R2 or R6 might be open or D2 might be installed backwards on the board. If all of the tests check okay but no oscillation occurs, then either Q1 or D2 might be defective.

The audio section is adjusted next. Set R13 for about 4.5 volts on pin 3 of IC3. Plug a pair of headphones into J1. You will probably hear some noise or "hiss" from the



headset. The volume should change as you adjust R7. The easiest and best way to adjust the sound is by using an actual short-wave reception. Adjust R6 until you hear a moderately strong station; adjust R13 until the audio sounds most clear to you.

The audio adjustment is quick and easy to make; however, the time of day and location can affect the quality of the Surface-Mount Shortwave Radio's output. The very best time to receive a shortwave signal is at night shortly after sunset. The antenna must also be fully extended and preferably outdoors. If you cannot stretch it outside, then do so inside a non-metallic-frame building. If you attempt to receive shortwave inside a metallic-frame building (like a commercial or industrial building) or during the day, you will hear few or no stations. Like most shortwave receivers, the Surface-Mount Shortwave Radio works best when referenced to an earth ground. The easiest way to do that is to make a strap connection to any cold-water pipe that runs into the ground.

**Troubleshooting.** Since the oscillator should have already been checked and adjusted, any problems will be located elsewhere. Before you begin the test procedures outlined below, you should first check all of your solder connections. Almost every problem is directly due to either an improper solder connection or an accidental solder bridge across adjacent traces. A lot of aggravation and trouble will be avoided if you thoroughly check the solder work first. If the soldering is okay and the receiver still does not work, then one of the following steps should help to isolate and solve any problems that might occur.

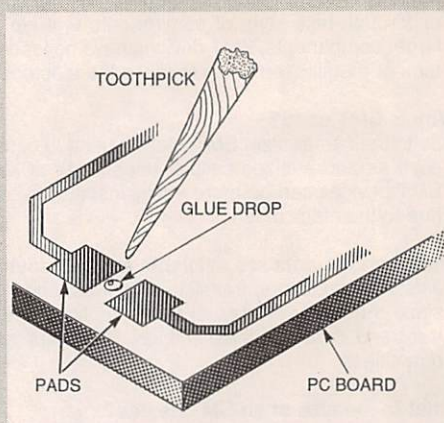
The first step in troubleshooting is to isolate the problem area. For example, is the problem in the RF or the audio portion of the circuit? Fortunately, you can determine that quite easily. Simply remove the antenna wire from its normal connecting point and reconnect it where FL1 meets the base of Q3. You should hear various local AM-

## HOW TO INSTALL A SURFACE-MOUNT DEVICE

Working with SMDs is a simple 3-step process when following the G-P-S (Glue-Place-Solder) method:

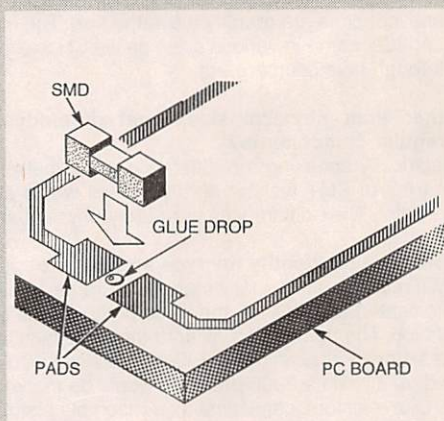
### Step 1: Glue

Because glue is used to hold the SMD in place, gluing is the first step in the installation process. The author recommends the plastic glue used to build model cars, but any good plastic glue will work. To perform this step, find the pads on the board and use the tip of a toothpick to lightly smear a drop of glue between them. For best results, you should clean and paste the board first as described in the Helpful Hints sidebar.



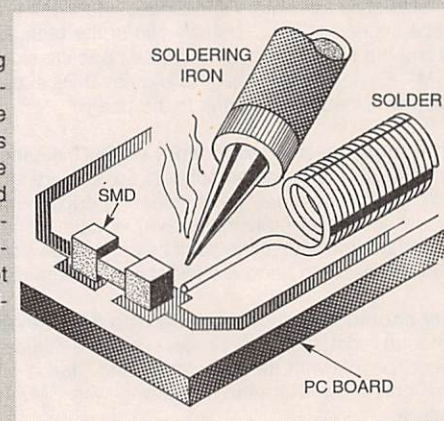
### Step 2: Place

This is the most critical step in the assembly procedure. After you have placed the glue, you must position the SMD on the board. A good set of tweezers is often the best tool to use. Centering does not have to be perfect but you must make sure that the metallic ends of the component touch the pads to either side.



### Step 3: Solder

Lightly touch the tip of the soldering iron to the metal end of the component. At the same time, place the tip of a solder strand against this point as well. Let this heat until the solder flows onto the part and board together making the connection. Remember, neatness is preferred but perfection is not required. Remove any excess solder with the wick.



broadcast stations through the headset when you do that. If you hear those stations, the receiver is operating properly from Q3 through to the headset; the problem exists between the antenna and the IF filter. Note that for that procedure to work well, you should

use the earth grounding method discussed earlier.

If the problem is in the RF section, you should check IC1, FL1, and the oscillator. The oscillator is the easiest to check—simply follow the adjustment procedure used earlier. If the signal still looks good on the oscillo-



## SMT—ANSWERS TO FREQUENTLY-ASKED QUESTIONS

### What is SMT? What is SMD?

The letters "SMT" stand for Surface-Mount Technology. The letters "SMD" stand for Surface-Mount Device. Those terms refer to a style of tiny, leadless electronic components that are made to mount on the PC board's surface as opposed to the larger through-hole style of components that we are more familiar with. Unlike those larger components, SMT devices have no leads. Instead, they use either small metal tabs or metallic terminals to make the electrical connections to the circuit board.

### Why is SMT used?

Due to their small size, SMT is often used to construct miniaturized electronic devices such as pocket-sized cellular telephones or keychain-sized car lock controls. Also, SMT devices can be more easily installed in some automated assembly processes due to their lack of leads.

### What components are available as SMT devices?

Resistors, capacitors, transistors, diodes, and ICs have been available in SMT style since the 1970s. Today, LEDs, potentiometers, crystals, inductors, fuses, connectors, and certain subassemblies like filters and oscillators are available in large quantities.

### What is the size of an SMT device?

Like many electronic components, SMT devices come in various styles and sizes. SMT resistors, for example, commonly come in  $\frac{1}{16}$ ,  $\frac{1}{10}$ ,  $\frac{1}{8}$ ,  $\frac{1}{4}$ , and 1-watt sizes. The  $\frac{1}{10}$ -watt size is 2.00 mm by 1.25 mm by 0.60 mm, while the 1-watt device measures 6.40 mm by 3.20 mm by 1.10 mm. Not surprisingly, the chip-style capacitors and inductors are roughly the same size. The other components, such as transistors and ICs, come in various sizes as well. However, they are usually smaller than their through-hole counterparts.

### Other than physical size, what differences are there between SMT and regular components?

Electrically speaking, no difference exists between SMT devices and their counterparts. An SMT resistor of 1000 ohms would act the same as a 1000-ohm leaded resistor. Their differences are purely physical and not electrical.

### How can you identify the type and value of an SMT device?

SMT resistors are usually manufactured as small black rectangular chips with metallic-coated ends. Often, the value of the device is printed in a numerical code across its top. The number is similar to the more familiar color-code bands found on leaded resistors. For example, a 390-ohm resistor would have "391" (3, 9, and 1 zero) printed on it while a 3900-ohm unit would be marked "392".

Like resistors, capacitors also resemble a small rectangular chip but they are usually either a yellow or gray in color. Unfortunately, these components don't have a value printed on them. You either have to refer to a manufacturer's reference or physically measure their value.

SMT-style transistors and diodes often look like small black squares but with metal tabs instead of leads. Usually two of the tabs are located on one side of the device while the third tab appears on the opposite side.

SMT ICs look very similar to regular DIPs except that they are generally smaller in size with leads that lay flat to the board.

### What tools are needed to work on SMT devices?

Virtually all electronic components are soldered to the board and SMT devices are no exception. Therefore, good soldering equipment is still required. While some shops use specialized (and expensive) equipment to do SMT soldering, a low-wattage standard iron with a fine point tip can still be used for many applications. Other good tools to have on hand are tweezers, a magnifying glass, glue, and soldering paste.

### Why should I practice working with SMT devices?

Although most assembly processes are automated, most repairs are not. Employers need people with the knowledge and "hands-on" skill to work with SMT; that need will only grow with time. Practicing with SMT is one good way to prepare for the future.

scope, it is operating properly.

The IF filter is the next component to test. Actually, it's a very easy part to test if you have an RF signal generator. Set the signal generator for an AM modulated output at 4.5 MHz and connect it to the filter input at C9. If the filter is okay, you should

hear the signal in the headset.

Check for 9 volts on pin 8 of IC1. If that voltage is present and the receiver still doesn't work, then IC1 might be defective or installed backwards. If it is in backwards, it is almost certain that if it wasn't defective to begin with, it probably

is now!

If placing the antenna wire on Q3's base causes no sound to be heard from the headset, the problem is in the audio section and it will involve Q3, IC3, or the audio-output section. The easiest way to troubleshoot those sections is to use the signal injection and tracing method. To do that, simply inject a 10-millivolt peak-to-peak 1000-Hz audio signal into the positive side of C11. If you hear that tone through the headset and it varies in loudness as you turn R7, then IC3 and the output stage are okay; the problem is with the Q3 amplifier/demodulator circuit.

If you do not hear the tone, disconnect the generator. Check the voltage level on the base of Q2. It should read somewhere between 2 and 3 volts DC; the level should vary as you adjust R13. If the proper voltage is on the base, then check the level on the emitter. That voltage should be about 0.7 volts less than the level on the base. Note that the headset must be plugged into J1 for the measurements to be accurate. If that voltage is missing or high, then either Q2, R11, C14, the headset, or J1 might be defective.

**Final Notes.** Shortwave listening makes for an interesting and worthwhile hobby. Millions of people throughout the world enjoy listening to shortwave and there's quite a variety to hear. There are news broadcasts, religious broadcasts, and even commercial rock-and-roll stations. Many broadcasts occur in English as well as most every spoken language on Earth.

Most important, those broadcasts originate from faraway countries with different ideas, cultures, and perspectives. A very good example of that occurred in 1989 with the fall of the Berlin Wall. Although that was a truly major historical event, most Americans knew about it from only a few short minutes of news broadcast each evening on network television. By contrast, those with shortwave receivers heard first-hand reports continuously throughout the event. Yet we did not hear these broadcasts from American journalists. Instead, we heard from

(Continued on page 50)



# TEST DIGITAL CIRCUITS WITH THE SMARTPROBE

*Replace your old logic probe with one that comes with a cap and gown—and the ability to resolve voltages to four levels as well as remember them!*

While a logic probe is an inexpensive piece of test gear that can be very handy when working with digital circuits, there are both positive and negative aspects to it. On the positive side, it's easy to use and gives you a quick view of what's going on in digital circuits. On the negative side, you get only three LEDs that tell you if the point being probed is low, high, or is pulsing between low and high. Of course, if all of the LEDs are off, the reading might be "floating" between the voltage thresholds for zero and one. That assumes that the instrument is working properly and that you've set it up correctly—like making sure not to accidentally switch the sensitivity to "CMOS" while testing a TTL-based circuit!

It's probably fair to characterize most basic logic probes as "dumb" instruments. Wouldn't it be nice to have a "smart" probe that gives you both visual and audible indications? How about adding the ability to display the status of the last 20 or so readings? While we're at it, let's add the ability to view the relative frequency and pulse width of signals on an oscilloscope-type display? Of course, it would be nice if you got all of those additional capabilities for about the same cost as that standard "dumb" logic probe.

The SmartProbe device presented here is such a device. Using an inexpensive LM339 comparator IC and a handful of other components, it connects to the parallel port of a PC. Like a standard logic probe, it senses the logic 0 and logic 1 "windows" of both TTL and CMOS devices, providing visual

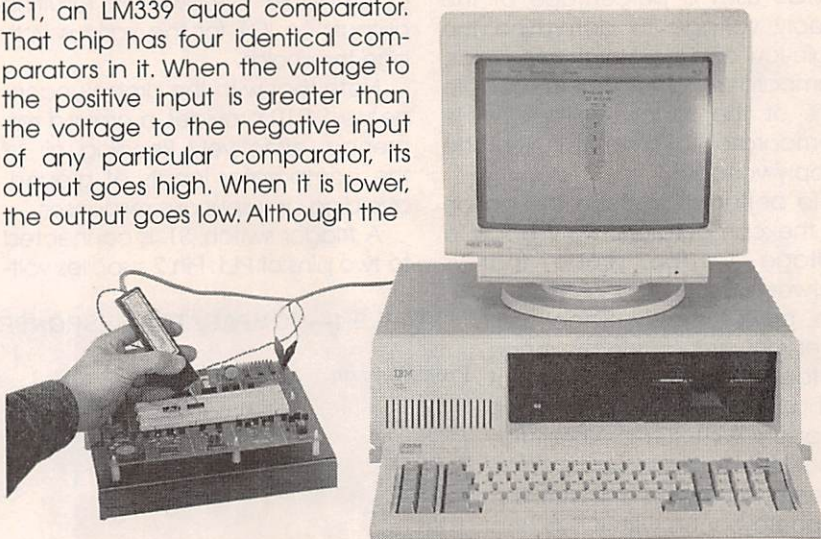
JAMES J. BARBARELLO

feedback of the detected logic state. The software lets your PC select a different audible tone for TTL and CMOS levels; keep a history of the last 20 readings; and show amplitude, frequency, and pulse-width characteristics on an oscilloscope-type display. Since it is a PC-based device, you can modify it to control other devices based on the sensed levels. It will work with any PC, from an old XT to tomorrow's newest model. The SmartProbe uses readily available components and doesn't require any special construction techniques. Even without any "junk-box" parts, the total cost is under \$15.

**How It Works.** The schematic diagram for the SmartProbe is shown in Fig. 1; refer to it during the following discussion. The heart of the circuit is IC1, an LM339 quad comparator. That chip has four identical comparators in it. When the voltage to the positive input is greater than the voltage to the negative input of any particular comparator, its output goes high. When it is lower, the output goes low. Although the

outputs of an LM339 do not actively produce a voltage to indicate a high output, we'll assume at this point in the description that they can do that; the outputs of IC1 will be discussed in greater detail later in this section.

The SmartProbe's tip is connected to one of the inputs on each comparator. Note that two of the comparators ("b" and "c") have the probe voltage going to their positive input, while the other two have the probe voltage going to their negative input. The other comparator inputs are connected to a voltage divider formed by R5-R9; that divider provides a reference level for each comparator. The resistor values chosen set the logic-low and logic-high voltage levels for both TTL and CMOS devices. With a 5-volt source, the reference voltage for comparator "a" is about





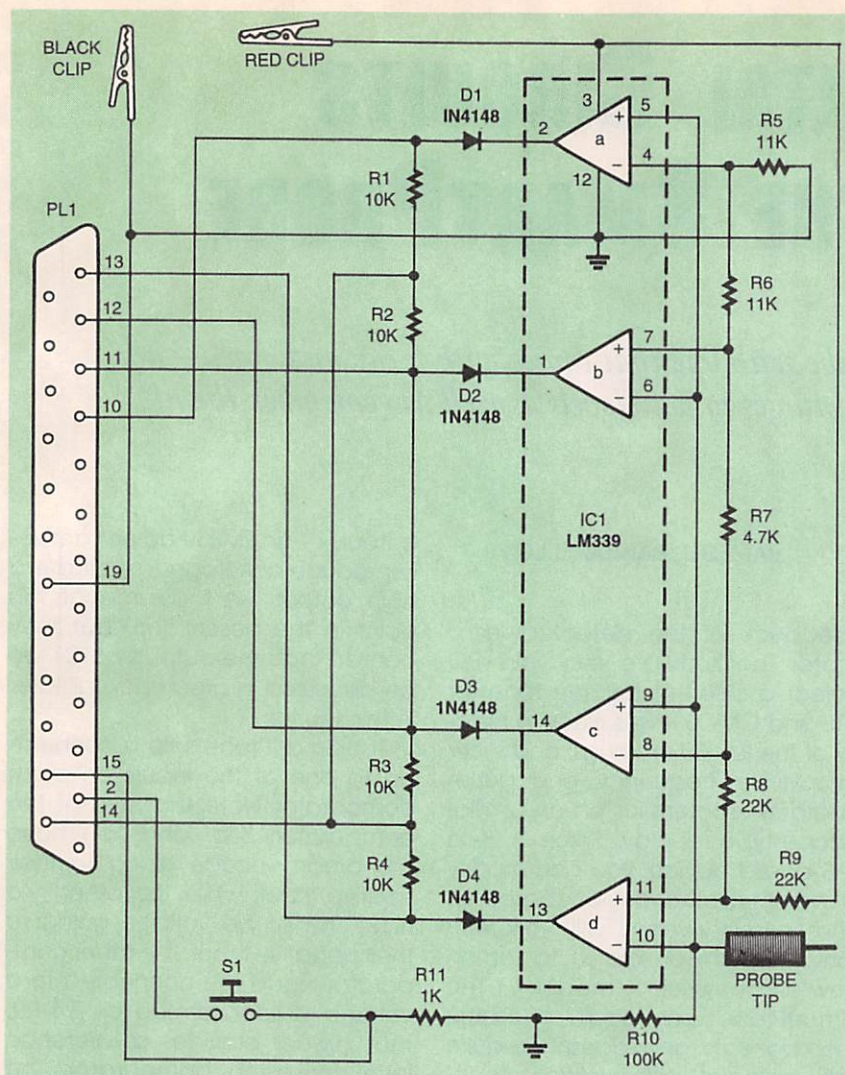


Fig. 1. The SmartProbe is built around a set of four comparators that can sense four different voltage levels. Those levels are set to the low and high logic levels of TTL and CMOS devices. Using an LM339 as well as a set of diodes lets the SmartProbe work with higher voltages without damaging the TTL circuitry in a PC's parallel port.

0.8 volts (TTL low) and about 2 volts for comparator "c" (TTL high). Since CMOS uses a percentage of the supply voltage to determine the logic-low and logic-high thresholds, comparator "b" is referenced to 30% of the supply voltage while comparator "d" is set to 70% of the supply voltage.

To better understand the action of the comparators, we'll apply a voltage to the probe that is between ground and 15% of the power supply. Since that level is lower than the reference voltage at R5/R6, IC1-a's output will go low. The same thing will happen with IC1-c since the input level is also lower than the reference voltage at R7/R8. The opposite occurs with IC1-b and

IC1-d because the probe voltage is being applied to the inverting inputs. Table 1 shows the resulting outputs on IC1 for the various voltage levels.

Note that with the probe unconnected, R10 provides a ground reference, effectively keeping all of the comparator inputs at ground, avoiding any spurious responses.

A trigger switch, S1, is connected to two pins of PL1. Pin 2 supplies volt-

TABLE 1—COMPARATOR RESPONSES

Probe Voltage	"a"	"b"	"c"	"d"
0%–15%	0	1	0	1
15%–30%	1	1	0	1
30%–40%	1	0	0	1
40%–70%	1	0	1	1
70%–100%	1	0	1	0

age to S1 (which will be set through the software) and pin 15 reads the current state of S1 (closed or open). When S1 is opened, R11 keeps pin 15 at ground level.

Using an LM339 for IC1 is the secret to powering the SmartProbe with voltages (as high as 18 volts for CMOS) that would otherwise destroy the circuitry in the computer's parallel port. Although the output of IC1 does not supply an active voltage when high (only grounding the output when low), blocking diodes D1–D4 and their associated pull-up resistors, R1–R4, give the open-collector outputs of IC1 additional protection in case something goes wrong with IC1.

### Reading SmartProbe Information.

First, let's review how a parallel port on a PC works. We'll assume that we're using LPT1; the decimal address of that port is 888. That port address is for outputting to the data lines of the printer. We want to read the five input pins that normally send feedback from the printer to the computer. That address is the base address + 1, or 889 in our example. If we want to look at a particular pin, we simply AND the read value with a "masking" value that strips away the data that we're not interested in. For example, if we want to look at pin 10, we would AND the reading from input port 889 with the value 64. If the result is 64, pin 10 is high; if it is zero, then the pin is low. The state of the other pins are forced to zero by the AND operation.

An oddity to remember is that pin 11 inverts its signal. Our software has to consider that in order to read data from the SmartProbe correctly.

Table 2 is simply Table 1 with the logic levels replaced with the values that our software would see when the input port is read. An additional column has been included: a sum of the read values. For example, if we read port 889, AND that data with 240 (to mask our four input pins), and find that the result is 208, we know that the SmartProbe is reading a voltage that is between 30% and 40% of its power supply.



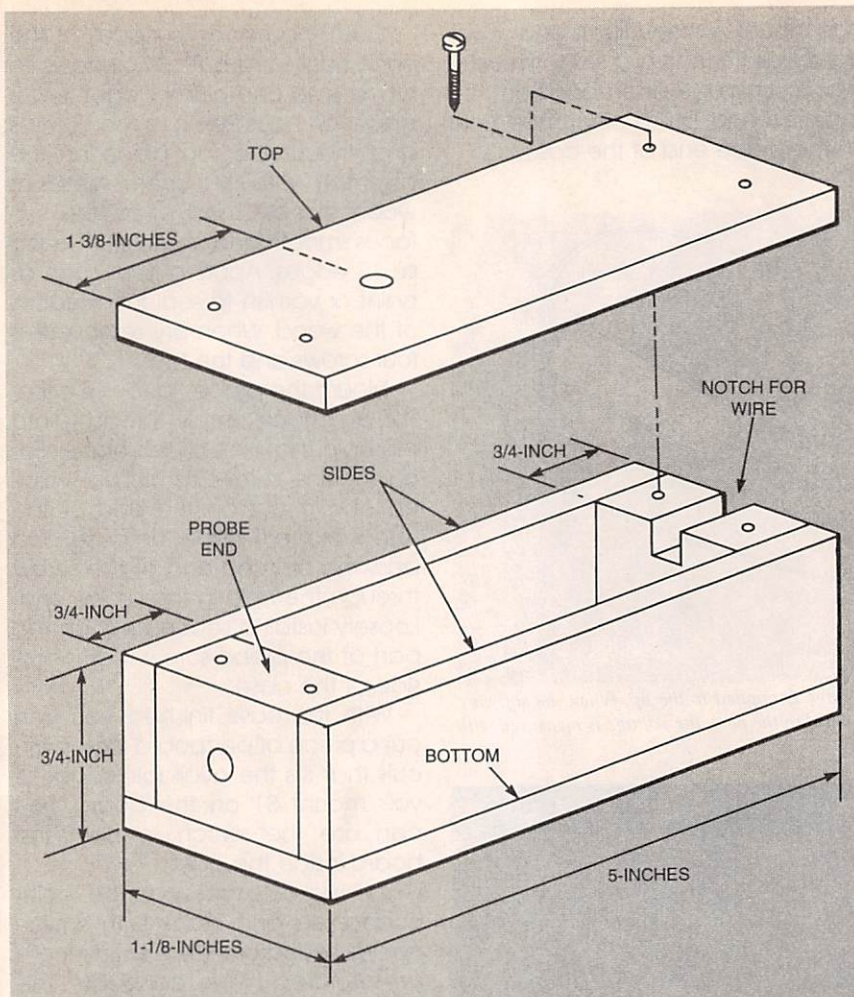


Fig. 2. The SmartProbe's case can be made from pieces of wood or plastic that are glued together. The result is a custom-designed unit that is comfortable to hold and use.

How those numbers relate to the logic levels of the SmartProbe are detailed in Table 3. For example, if the SmartProbe is sensing a voltage between 40% and 70% of its power supply, the read value is 240. That value represents a valid logic high for TTL circuitry, but is below the logic-high threshold for CMOS devices.

One final detail is how S1 is read: simply mask the input data with 8. A value of 8 means that S1 is closed; if it is open, the value will be zero.

**Construction.** Building the SmartProbe is very simple and straightforward. None of the circuitry is sensitive or high-speed. You can use a piece of perfboard and standard construction techniques.

Before building the circuit, we will need the case to know how much room we have to work with. The author's prototype was built from

1/8-inch-thick wood. The overall dimensions are shown in Fig. 2. Those dimensions result in a case that is large enough inside to hold all of the electronics, yet is comfortable to hold like an oversized pencil. The author's prototype can be seen in Fig. 3, showing all of the parts that go into building the SmartProbe.

A notch will be needed in the

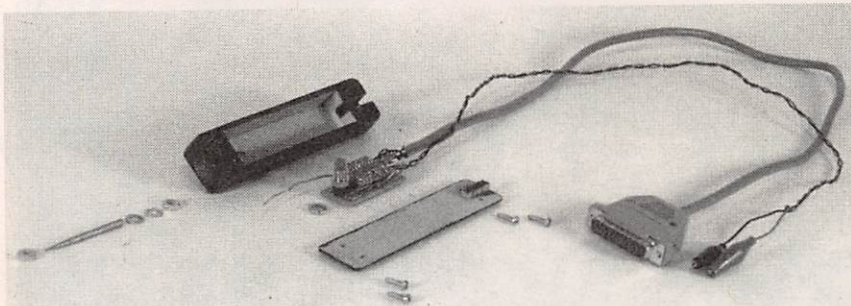


Fig. 3. The author's prototype uses a stacked-board arrangement for the circuit board; a single board will fit in the space just as well.

## PARTS LIST FOR THE SMARTPROBE

### SEMICONDUCTORS

IC1—LM339 quad comparator, integrated circuit  
D1—D4—1N4148 silicon diode

### RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)

R1—R4—10,000-ohm  
R5, R6—11,000-ohm, 1/4-watt, 1%  
R7—4700-ohm  
R8, R9—22,000-ohm  
R10—100,000-ohm  
R11—1000-ohm

### ADDITIONAL PARTS AND MATERIALS

PL1—DB-25 male connector  
S1—Single-pole, single-throw, momentary-contact switch, normally open  
DB-25 non-shielded hood, 9-conductor cable, black and red mini-alligator clips, wire, hardware, etc.

**Note:** The following item is available from James J. Barbarello, 817 Tennent Road, Manalapan, NJ 07726: A 3 1/2-inch floppy disk containing the SmartProbe software plus additional material (both source and executable code), Part No. SP-S, \$12.00. Check or money order must be payable in US funds. NJ residents must add appropriate sales tax. The author will be happy to answer any questions that are accompanied by a stamped, self-addressed envelope.

back end of the case for the power clips and the cable that will be attached to the parallel port. Don't forget to drill a hole for S1. If you mount S1 on the bottom side of the case, it will be easier to assemble the unit—no wires will need to be attached to the top of the case.

The probe tip itself can be a solderless tip jack or, if one is not avail-



able, it can be formed from a machine screw. If you're using a tip jack, drill the mounting hole slightly smaller than the threads on the probe tip. To form a probe tip from

the machine screw, file its end down to a point, forming a smooth taper approximately  $\frac{3}{4}$ -inch long from the pointed end. Drill a clearance hole in the probe end of the case.

Coat the mating surfaces of the ends, sides, and bottom pieces with wood glue and clamp together for about an hour. Remove the clamps and mount the top piece on the assembly with four sheet metal or wood screws. Sand all of the surfaces smooth and chamfer or round all 12 edges. Apply a finish such as paint or varnish to seal the surfaces of the wood. When dry, remove the four screws and the top.

Mount the probe tip to the case. For a tip jack, simply thread it into the hole that was drilled earlier. For a machine screw, install two washers and a nut on the end of the screw, place it inside the case, and pass the pointed end of the screw through the hole in the probe end. Loosely install a second nut on the part of the probe screw that is outside of the case.

With the case finished, you can cut a piece of perfboard for the circuit that fits the available space. If you mount S1 on the board, you can use the switch to hold the board inside the case.

The power wires can be color coded red and black with similar-colored alligator clips. A short length of insulated wire connects the probe tip to the circuit board. If you are using a machine screw, wrap the bare end of the wire around the screw between the two washers and tighten one of the nuts; the outside nut might be easier to reach. The data cable should be shorter than ten feet—four to six feet is a common length. Once it is wired up, install a DB-25 hood on PL1.

Once everything is mounted in the case, inspect your work before closing it up.

### Testing and Using the SmartProbe.

Basic software for the SmartProbe is available from the Gernsback FTP site ([ftp.gernsback.com/pub/EN/smartprobe.zip](ftp://ftp.gernsback.com/pub/EN/smartprobe.zip)); it contains the set of compiled programs that will let the SmartProbe be used in its basic functions. The software available from the source given in the Parts List includes additional programs as well as source code. While the main application can be run on even the oldest non-graphics PC, the Scope function (discussed later) requires an EGA or

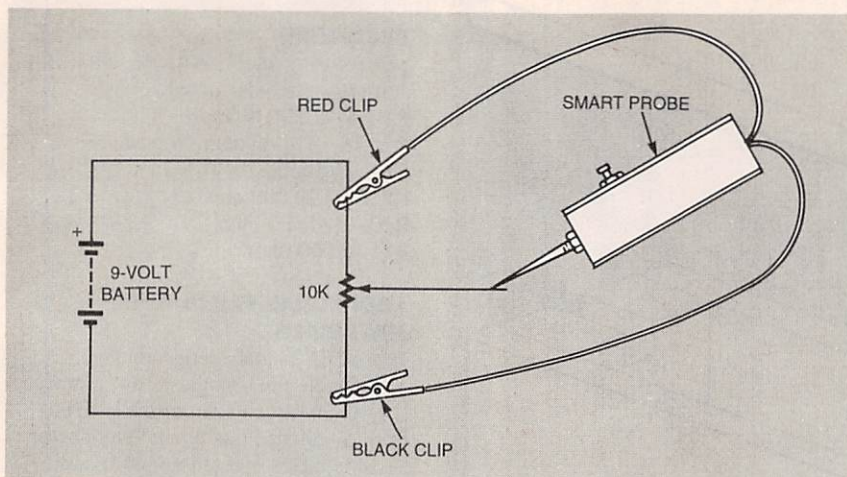


Fig. 4. To test the SmartProbe, a simple variable voltage is applied to the tip. When the software indicates that the SmartProbe has changed from one level to the next, the voltage is measured with a voltmeter to verify that the unit is working correctly.

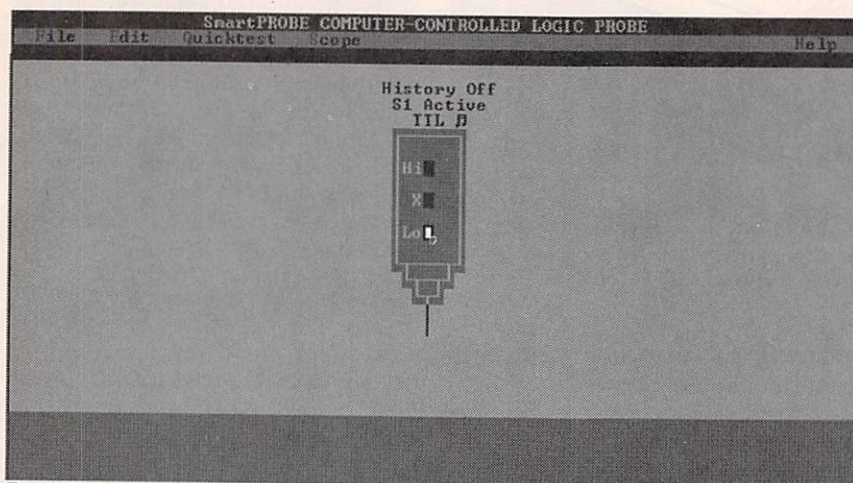


Fig. 5. The main screen of the SmartProbe software lets you easily choose the various settings and options.

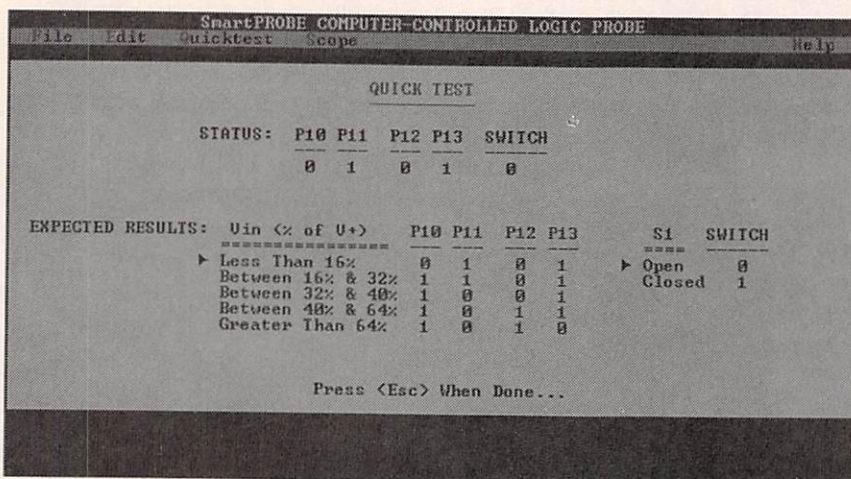


Fig. 6. When testing the unit, this screen tells you what the SmartProbe is reporting. The information at the bottom of the screen is a handy reference for testing the hardware.



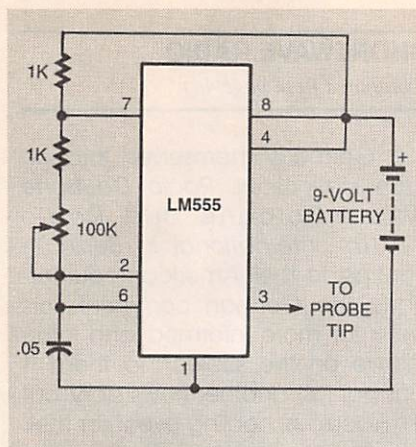


Fig. 7. This simple LM555-based oscillator shows the SmartProbe's ability to act like a poor-man's digital-storage oscilloscope.

better monitor.

The simple test circuit shown in Fig. 4 will be used to test the SmartProbe. Although a 10,000-ohm value is shown for the potentiometer, any value between 1000 ohms and 1 megohm can be used; the voltage source can be anywhere between 5 and 15 volts.

Connect the red and black power leads of the SmartProbe as shown and plug the SmartProbe into the printer port. After the software has been stored on the PC in a directory of your choice, type "SP" at the DOS prompt to start the program.

Once you see a startup screen with some initial instructions, press any key. The instructions will be replaced by a graphical representation of a logic probe as shown in Fig. 5. Press <ALT> Q to perform a Quick Test. You should see a screen similar to the one shown in Fig. 6. Note that the SmartProbe's current status is to the right of the STATUS indication; expected results are listed in the lower half of the screen. Press S1 on the SmartProbe and notice that the switch indication changes from "0" to "1". Release S1 and the indication should return to "0". Hold the SmartProbe's tip against the wiper of the potentiometer and turn the potentiometer's shaft. The "P10 P11 P12 P13" indications should change to one of the five conditions listed under EXPECTED RESULTS. If you do not get one of those indications, check the unit for component, connection, or construction errors; fix any errors as needed.

TABLE 2—PARALLEL PORT RESPONSES

Probe Voltage	Pin 10	Pin 11	Pin 12	Pin 13	Read Value
0%–15%	0	0	0	16	16
15%–30%	64	0	0	16	80
30%–40%	64	128	0	16	208
40%–70%	64	128	32	16	240
70%–100%	64	128	32	0	224

When the SmartProbe is giving a correct indication, measure the DC voltage at the point when the SmartProbe changes from one condition to the next. The voltage should be approximately as expected; there might be some variation based on the actual value of the components used. For example, the voltage between the "0 1 0 1" and "1 1 0 1" transition should be about 1.35 volts with a battery voltage of 9 volts. If you do not get those results, check the value and placement of resistors R5–R9 and correct any problems that are found.

To complete initial testing, press the <ESC> key to return to the program's main screen.

Now that you've used the Quick Test function, let's quickly review the other four menu choices (File, Edit, Scope, and Help) available from the main screen (Fig. 5). The File menu (accessed by pressing <ALT> F) contains the DOS Shell and Exit commands. Pressing S for DOS Shell temporarily brings you to a DOS prompt where you can perform normal DOS functions. Type EXIT and press <ENTER> to exit the DOS shell and return to the pro-

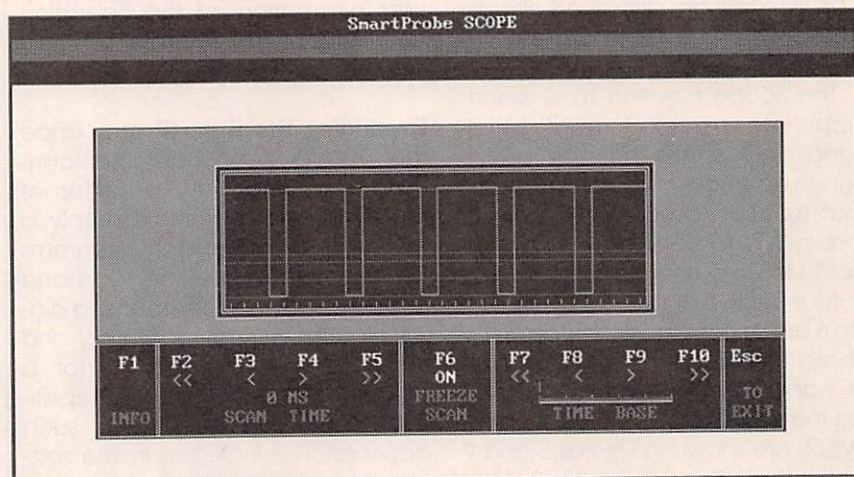


Fig. 8. When using the SmartProbe to check the output of the circuit shown in Fig. 7, the output pulse is accurately displayed.

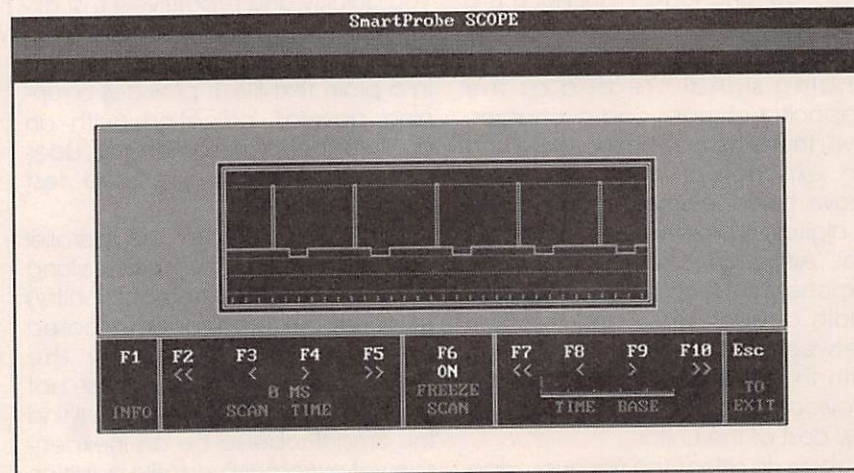


Fig. 9. Since the SmartProbe can sense four different voltage levels, it can be used to read simple analog signals. Here is the signal on the capacitor of the circuit shown in Fig. 7.



gram. To end the program, press X for Exit.

The Edit menu contains five commands: Toggle History, Toggle Sound, Toggle S1, TTL, and CMOS. Pressing H for Toggle History turns the History display on (if it was previously off), or off (if it was previously on). The History On command displays the previous 20 readings; each reading is stored when S1 is closed or the last 20 changes in reading if S1 is disabled. Toggle S1 enables and disables S1. With S1 enabled, a reading will only be taken when S1 is depressed. Disabling S1 allows for continuous readings. Pressing S for Toggle Sound turns the audible indication on or off accordingly. Pressing T for TTL switches the SmartProbe to the TTL mode. Pressing C for CMOS switches the SmartProbe to the CMOS mode. The current status of History, S1 status, Sound, and TTL or CMOS mode are displayed directly above the graphical representation of the SmartProbe.

The Scope function turns SmartProbe into a simple form of digital-signal oscilloscope that can resolve signals up to about 10 kHz. To try out that function, build the test circuit shown in Fig. 7. That circuit is a standard LM555-based oscillator with its output at pin 3. Pin 2 is connected to pin 6 and makes the oscillator run by charging and discharging the 0.05- $\mu$ F capacitor. The results of measuring the signals at pins 3 and 2 of the LM555 are shown in Figures 8 and 9 respectively. Since the output of pin 3 is a digital signal varying between logic low and logic high, Fig. 8 is a true representation of that signal. The signal at pin 2, however, is an analog signal created as the capacitor charges and discharges. It will therefore have a sharp rise and an exponential decay. Figure 9 shows how the SmartProbe creates a digital approximation of that signal. Although it can't show the exponential decay, it can show the width of each pulse and the time between each voltage level. Even with that limitation, the SmartProbe provides a lot of information for the low cost of the unit.

You can select the various scope functions with the ten function keys. For instance, F2 through F5

adjust the scan time (the time between subsequent scans). Since there is no sync input, the display tends to jitter; increasing the scan time reduces that jitter. When you want to examine a particular scan, you can freeze the display by pressing F6. Function keys F7 through F10 control the time base (somewhat like a time base on a standard

TABLE 3—TTL, CMOS LEVELS

Value	TTL	CMOS
16	Low	Low
80	open	Low
208	open	open
240	High	open
224	High	High
0	S1 Open	S1 Open
8	S1 Closed	S1 Closed

oscilloscope). Pressing the Escape key returns you to the main screen.

The Help function is a non-context sensitive help file that provides user information on the operation of the program and on the SmartProbe hardware.

**Expanding the SmartProbe.** Since the SmartProbe is computer controlled, adding new or different functions and features is simply a matter of writing custom programs for those who have the tools and need. For instance, those doing digital-electronics manufacturing and repair are always looking for a quicker and easier way to repetitively check circuits. One such application is included in the software bundle available from the source given in the Parts List. It lets you quickly and repetitively test circuits based on a test specification that you develop (and document) in a plain text file. It provides a running pass-fail indication (with an audible beep if something does not comply) and a printed test report if needed.

You can also use the parallel port's unused output pins (along with appropriate external circuitry) to control external devices based on the levels sensed by the SmartProbe. Even if you choose not to expand its capabilities, you'll find the SmartProbe to be an inexpensive yet extremely versatile addition to your test bench. Why not build one today!

## SHORTWAVE RADIO

(continued from page 44)

the Germans themselves through such stations as *Radio Deutsche Welle* in Cologne and *Radio Berlin International* in Berlin. In contrast to their American counterparts, the German commentators were far more informed and informative on the subject. To them, it was not just another news story, but a miraculous, healing event for their people and their country. They not only reported the facts of the event but told the stories, the meanings, and the emotions behind it as well. Through the power of shortwave radio, they both clearly and eloquently conveyed to the world just what the fall of the Wall meant to Germany and did so in a depth and style that the other journalists could not understand, much less appreciate or convey.

Another fine example of shortwave listening occurred during the Persian Gulf War. When the American public discovered that some of the international stations were continuously broadcasting the war news both day and night, most stores selling shortwave receivers sold out in a few hours time.

Simply put, shortwave listening can be both educational and entertaining in itself. Many of the broadcasts, whether in English or another language, give a glimpse of another place and people. Listen for awhile; you just might enjoy what you hear.

Ω

**Yours for only  
\$3.99**

**Prices includes  
shipping!**



**HAVE A THOUSAND YUCKS FOR ONLY THREE AND A HALF BUCKS!** That comes to one-third of a cent per laugh. Electronics Comics is a compilation of over 125 riotous, outrageous and phenomenal cartoons that appeared in *Popular Electronics* and *Electronics Now*. Only \$3.99—price includes shipping. Claggk, Inc., Reprint Bookstore, P.O. Box 4099, Farmingdale, NY 11735-0793. All payments in U.S. funds. Sorry, no orders outside U.S.A. and Canada. Check or money order only—send no cash. NY state residents add applicable tax.

MA04



# MEASURING RF POWER

**R**adio frequency (RF) power is one of the principal performance indicators of radio transmitters. Whether you are a ham-radio operator, citizen's-band operator, or a commercial radio-communications technician, the RF-power output of your transmitters is a key indicator of its health. RF power measurements vary from a few milliwatts up to many kilowatts. In this article we will take a look at some of the principal methods for measuring RF power.

RF power measurement is no different from other alternating-current (AC) power measurements, although the increased frequencies involved cause some problems. Power is still described by the standard equations ( $P = V \times I$ ,  $P = I^2 \times R$  and  $P = V^2/R$ ), so if you can measure the current or voltage and know the resistance, you can measure power. The problem is relatively easy with sine-wave RF, such as unkeyed continuous wave (CW) signals, but becomes a bit more complicated on modulated, chopped, keyed, or pulse RF waveforms. In any event, the most basic power level measured is the root-mean-square (rms) value, which equates the power's heating ability to a like amount of heating from a DC source. The trick is in making rms readings.

**RF Ammeter Methods.** The thermocouple RF ammeter (see Fig. 1) is an inherently rms-reading device because it relies on heating a very low value resistive heating element (R). The temperature of the heating element is measured by a thermocouple device (TC in Fig. 1), which produces a voltage proportional to the temperature of the thermocouple junction. A DC voltmeter is used



*Your transmitter's RF power output is a key indicator of its health, and here are the circuits, instruments, and techniques you can use to accurately "take its temperature."*

JOSEPH J. CARR

to measure the thermocouple output, but its scale is calibrated in units of current (amperes, milliamperes).

When the RF ammeter is in series with the transmission line from the transmitter to a resistive load ( $R_L$ ) or a resonant antenna, the rms RF power level can be calculated from  $I^2 \times R_L$ . The advantage of the thermocouple RF ammeter is that it can be used with any load resistance, while other meters are designed for a specific load (usually 50-ohms). The disadvantages include the need to make a calcula-

tion, and the fact that RF ammeters tend to fade out above some frequency in the 40- to 70-MHz range.

**Calorimeter/Bolometer Methods.** A number of professional-grade RF-power meters are based on the fact that the temperature change in a resistive load is proportional to the rms value of the applied RF waveform. Figure 2 shows a basic form of calorimeter or bolometer: A heat-dissipating resistor with a resistance value equal to the desired load impedance is enclosed in an assembly with some sort of temperature-measurement device.

Theoretically, you could put a big dummy load in a room and use a glass-mercury thermometer to measure the air temperature of the room before and after the power was turned on, but that's hardly practical. If, however, you embed a dummy load and some temperature sensor (thermistors and thermocouples are used) in a small assembly, then the before and after temperature rise of the resistor can be measured.

A low-cost instrument can be built using only the dummy load and Temperature Sensor 1, but that would ignore the

problem that ambient temperature also affects the measurement sensor. It is not uncommon to include a second sensor to measure ambient temperature, so that changes in ambient temperature can be factored into the measurement. The results can then be displayed on an analog or digital meter.

Some calorimeter methods use two sensors (three could be used if ambient is accounted for) in a comparison measurement. A low-frequency (e.g. 60-Hz) AC power source is used to drive one sensor/resistor, while the RF power is used to drive the other. A differential



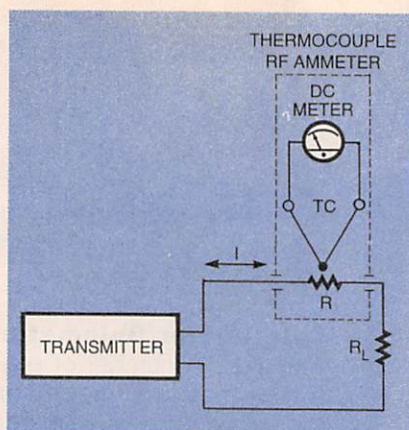


Fig. 1. The thermocouple RF ammeter relies on heating a very low value resistive heating element ( $R$ ) to measure RF power.

meter will show when the two output levels are the same. At this point, the easily measured 60-Hz AC power level is equal to the applied RF power.

### Simple Diode Detector Methods.

A simple diode detector scheme (see Fig. 3) can be used to measure the RF power applied to a load. The scheme shown was used on the Heathkit *Cantenna* dummy load that was popular some years ago, and is still used on similar products today.

The diode is an envelope detector, and produces a pulsating DC output from the RF voltage applied across the load ( $R_L$ ). Capacitor  $C_1$  filters out the pulsations to pure DC. The power can be inferred from  $V_o^2/R_L$ .

The actual voltage applied to the diode is reduced by a resistive voltage divider ( $R_1/R_2$ ) and is only a fraction of the applied voltage. This allows higher power levels to be measured. A diode such as a germanium 1N60, a silicon 1N914 or 1N4148, or a Schottky diode can be used for  $D_1$ . Note that both  $R_1$  and  $R_2$  should be much larger than the load ( $R_L$ ). Typical values for the circuit are  $R_1 = 100,000$  ohms,  $R_2 = 1000$  ohms, and  $C_1 = 0.05$ - $\mu$ F.

The diode detector circuit of Fig. 3 remains popular because it is simple and easy to implement. But it suffers from the fact that it measures the approximate peak power, not the rms power. On a sinewave CW signal, the rms power can be approximated by  $(0.707 \times V_o^2)/R_L$ .

52 **In-Line RF Wattmeters.** Perhaps

**TABLE 1—METER READINGS  
BASED ON 100-WATT RMS CW CARRIER**

Waveform	PEV <sub>rms</sub>	PEP(PEV <sup>2</sup> / $Z_o$ )	Thermal Power
CW	100/1.414 V	100 W	100 W
AM (100%)	200/1.414 V	400 W	150 W
AM (73%)	173/1.414 V	300 W	127 W
SSB (1 tone)	100/1.414 V	100 W	100 W
SSB (2 tone)	100/1.414 V	100 W	50 W

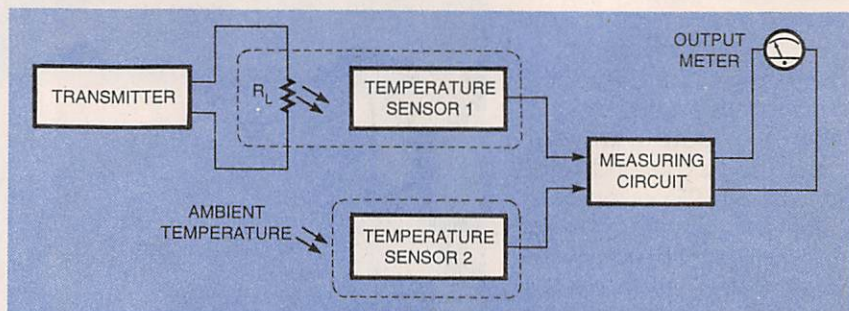


Fig. 2. In the bolometer/calorimeter approach to measuring RF power, a heat-dissipating resistor with a resistance value equal to the desired load impedance is enclosed in an assembly with some sort of temperature-measurement device. A number of commercial devices are based on this approach.

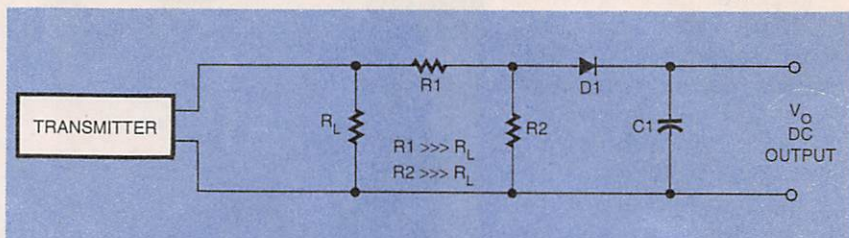


Fig. 3. A simple diode detector scheme shown here was used on the Heathkit *Cantenna* dummy load that was popular some years ago, and is still used on similar products today.

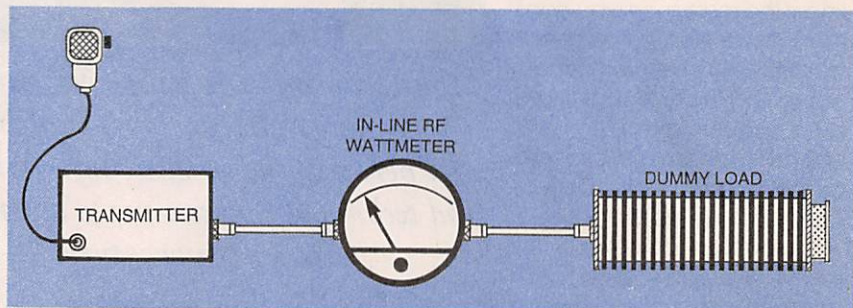


Fig. 4. Almost all RF wattmeters in use today are the in-line type.

the most common forms of RF power meter is the in-line wattmeter (see Fig. 4). The instrument is inserted in the coaxial line between the transmitter and either the antenna or a dummy load. Instruments designed for use with an antenna often have the ability to measure the forward and reflected power, so they can also be used to determine the standing wave ratio (SWR).

The classic Wheatstone bridge can theoretically be used for making an in-line RF wattmeter, but that is not a practical approach.

Such bridges are useful for making antenna impedance measurements at low power levels, but they cannot be left in-line because of the huge insertion loss involved. Other bridges, such as the micro-match bridge, discussed next, are used instead.

**Micromatch Bridge.** Figure 5 shows the basic capacitor-resistor micro-match-bridge circuit. Immediately we see that the micromatch is better for those applications than a conventional Wheatstone bridge because it only places a 1-ohm resistor



(R1) in series with the transmission line. That resistor dissipates considerably less power than the resistors typically used in Wheatstone bridges. Because of that low-value resistance we can leave the micromatch in the line while transmitting.

As with Wheatstone bridges, the ratio of the resistances and/or reactances in the arms must be equal to create a null output to the meter. In that case, the ratio of the capacitive reactances of C1 and C2 must match the ratio of R1 and the antenna or load resistance  $R_L$ :

$$X_{C1}/X_{C2} = R1/R_L$$

For a 50-ohm load, the ratio is 1/50, while for 75-ohm loads it is 1/75. A compromise situation that yields a small error on both 50-ohm and 75-ohm systems is to use a 68-ohm value for  $R_L$ , and make the ratio  $X_{C1}/X_{C2} = 1/68$ . These ratios occur when  $C2 \approx 15$  pF for 50-ohm systems,  $C2 \approx 10$  pF for 75-ohm systems, or  $C2 \approx 12$  pF for the compromise 68-ohm value.

The sensitivity control can be used to calibrate the meter. For fixed power meters, that potentiometer can be a trimmer type that is set when the meter is calibrated, and then left alone. At least one commercial micromatch bridge that was once popular with CB service technicians used a three-position switch to select three different sensitivity controls for 10-watt, 100-watt or 1000-watt power levels. Each range has its own sensitivity control, and those are used as needed.

**Monomatch Bridge.** The monomatch bridge of Fig. 6 is one of the "instruments of choice" for hams and other users for measuring RF power in the HF and low VHF ranges. In the monomatch design, the transmission line is segment "B", while the directional coupler transmission line segments are "A" and "C". The directional coupler lines are used for sampling the forward and reverse RF signals. Although some instruments used modified coaxial transmission lines, later versions use PC-board elements for A, B and C.

The sensor unit is basically a directional coupler with a diode detector element for both forward

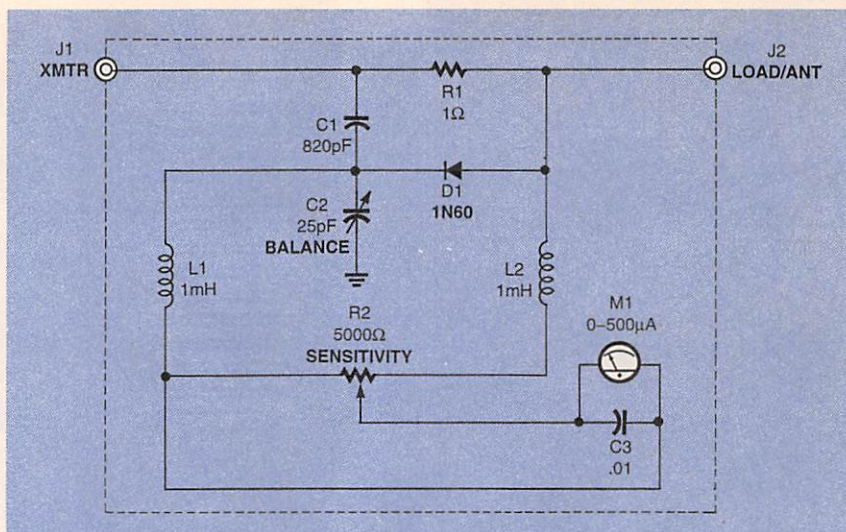


Fig. 5. The micromatch RF wattmeters offer important advantages over traditional Wheatstone bridges in RF power meter applications because they dissipate less power, allowing them to be left in the line.

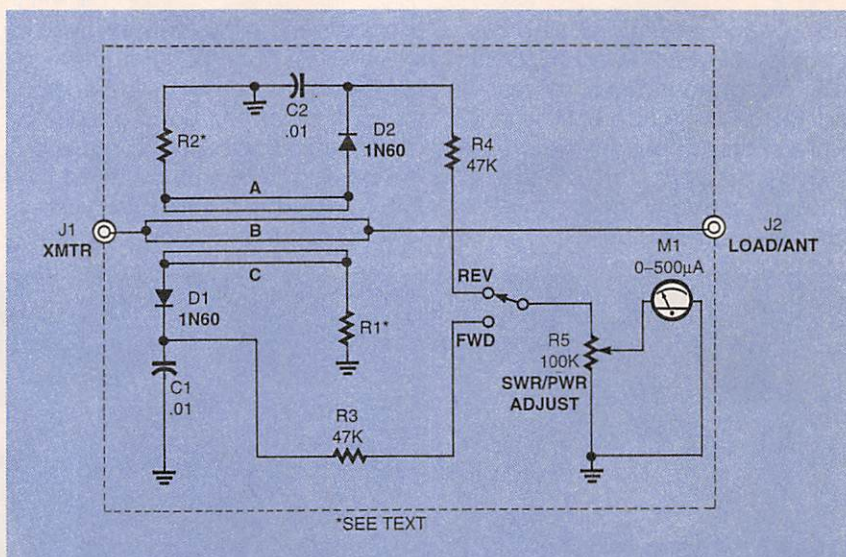


Fig. 6. The monomatch RF wattmeter is one of the "instruments of choice" for hams and other users for measuring RF power in the HF and low VHF ranges.

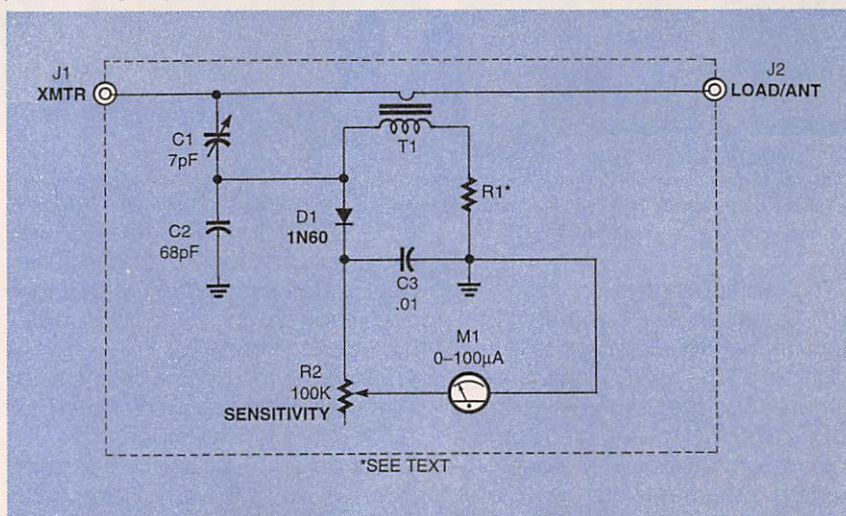


Fig. 7. In this version of the monomatch RF wattmeter, a single-turn ferrite or powdered-iron toroid is used as the directional coupler.



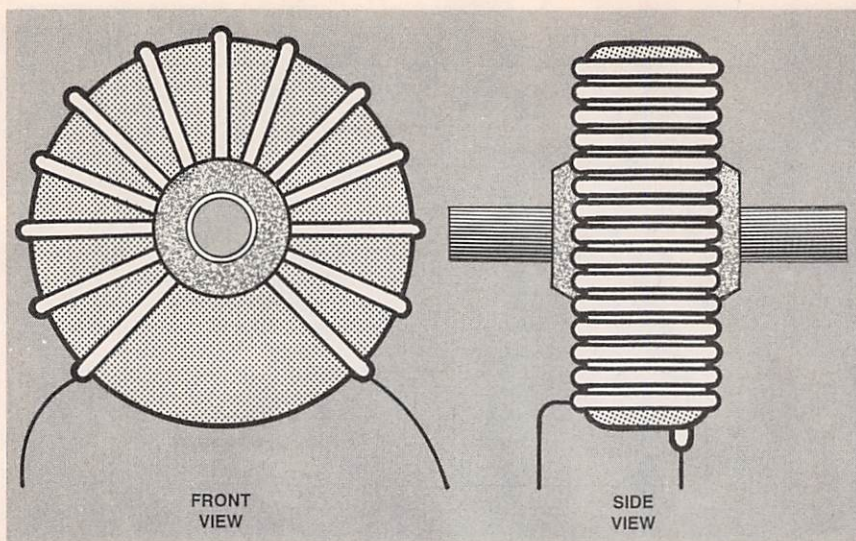


Fig. 8. Here are the winding details for the toroid transformer in the monomatch RF wattmeter in Fig. 7.

and reverse directions. For best accuracy, diodes D1 and D2 should be a matched pair, as should R1 and R2. The resistance of R1 and R2 should match the transmission-line characteristic impedance, although in many cases the 68-ohm compromise is used.

a transmission-line transformer as shown in Fig. 7. In that instrument, a single-turn ferrite or powdered-iron toroid transformer is used as the directional coupler. The transmission line passing through the hole in the toroid "doughnut" forms the primary winding of the transformer. The sec-

ondary winding is a single conductor passing through the hole. It is common to find  $1/8$ -,  $3/16$ -, or  $1/4$ -inch brass tubing used for the primary. Note: When counting turns on a toroidal transformer, each pass through the hole is a "turn," so passing a straight wire or tube through the toroid hole once counts as one turn.

The value of R1 should match the transmission-line impedance, although, as usual, the 68-ohm compromise is often seen. If you opt to use the exact value in any of those circuits, then you can use either a single 51-ohm resistor, or two 100-ohm resistors in parallel. If you can find a precision 50-ohm resistor, however, use it (in standard carbon-composition or metal-film resistors, 51 ohms is a standard value, but 50 ohms is not).

**Complex Waveforms.** Measuring the RF power of unkeyed CW waveforms is relatively easy, but when modulation is applied, many instruments will read incorrectly. Table 1



Fig. 9. The Bird Electronics Model 43 RF wattmeter is an old war horse that has served the author well over the years (photo courtesy of Bird Electronics Corporation).

The particular version shown in Fig. 6 uses a single DC meter movement to monitor RF power. With the addition of the switch and potentiometer R5, the circuit becomes both an SWR meter and a forward/reverse RF-power meter. Many modern instruments use two meter movements, one each for forward and reverse power.

A variation on the theme uses



Fig. 10. Bird Electronics Model 4421 RF wattmeter (photo courtesy of Bird Electronics Corporation).

ondary winding consists of 10 to 20 turns of small gauge enameled wire and is connected to a measurement bridge circuit (C1, C2, plus the load) that produces a diode-rectified output voltage.

Details for the construction of the sensor assembly is shown in Fig. 8. The secondary winding, made of 24- to 30-gauge enameled wire, is wound as shown in Fig. 8, with at least a 30 degree separation between the ends to minimize distributed capacitance. A rubber grommet is in-

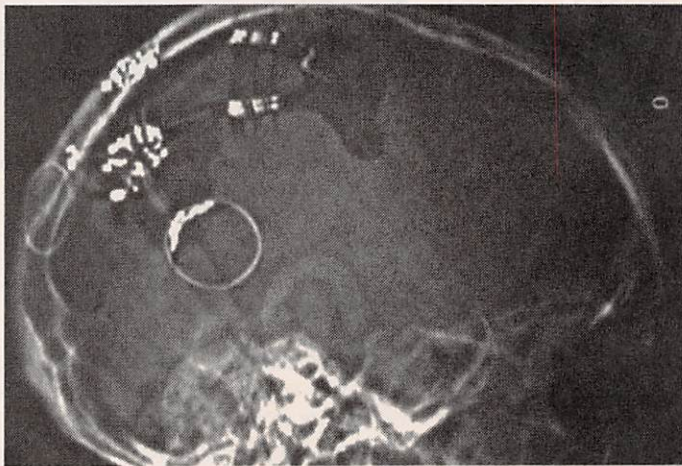
serted into the hole of the toroid. The primary winding is a single conductor passing through the hole. It is common to find  $1/8$ -,  $3/16$ -, or  $1/4$ -inch brass tubing used for the primary. Note: When counting turns on a toroidal transformer, each pass through the hole is a "turn," so passing a straight wire or tube through the toroid hole once counts as one turn.

**Some Commercial Instruments.** Figure 9 shows a commercial RF power meter that the author bought nearly thirty years ago and has used heavily ever since. It is the Bird Electronics Corporation (30303 Aurora  
(Continued on page 56)



# A BRAIN/COMPUTER INTERFACE

*An amazing breakthrough could one day allow the paralyzed to communicate and interact with the world around them.*



BILL SIURU

**A**s someone who has experienced complete paralysis from spinal cord surgery, this author knows the utterly demoralizing frustration of not being able to communicate with the outside world. Fortunately, I recovered (essentially) completely. Many people don't, and as a result have to live in complete isolation with ideas and words that can't be shared with anyone.

There is a chance, however, that all of that could change. Dr. Roy E. Bakay and Dr. Phillip R. Kennedy, neuroscience researchers at Emory University in Atlanta, GA have achieved a breakthrough that promises a way for those left paralyzed and unable to speak from a spinal cord injury, stroke, or diseases like Lou Gehrig's disease to communicate.

More than 700,000 Americans suffer from stroke each year and tens of thousands more suffer spinal cord injuries or from diseases like Lou Gehrig's that threaten their ability to communicate. Stroke is currently the leading cause of permanent adult disability in the U.S.

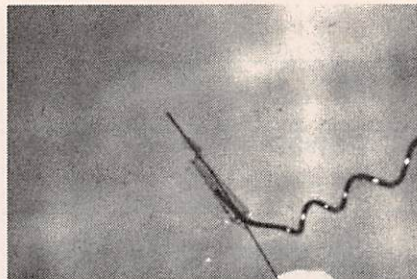
The researchers have developed a neurotrophic electrode (an electrode implanted with nerve-growth factors) that can be implanted in the brain to allow speech-incapable patients to communicate via a computer. According to Dr. Bakay, "A person

can interact with the world if they can use a computer." If someone can move the cursor on a computer, that person can stop on icons to produce phrases, send e-mail, turn on or off a light, and, in general, interact with the outside world in an effective manner.

**How It Works.** The heart of the concept is the neurotrophic electrode that makes the connection with the brain. The neurotrophic electrode, which is housed in a tiny cone-shaped glass casing, is implanted into the motor cortex. The electrode is about 1.5 mm long and 0.1 to 0.4 mm in diameter. Nerve growth factors are implanted into the glass cone, and the cortical brain cells are induced to grow into the electrode's tip and form contacts. It takes several weeks to three months for the cortical tissue to grow into the electrode; the process is considered complete when the resulting signals become stable.

The neurons in the brain transmit an electronic signal when they "fire." Gold recording wires are placed inside the glass cone to pick up the neural signals from the ingrown brain tissue and transmit them through the skin to a receiver and amplifier outside the scalp. The system is powered by an induction coil placed over the scalp so wires for powering the device do not

have to pass through the skull. Signal processors are used to separate individual signals from the multiple signals that are recorded from inside the conical electrode tip. These signals are used to drive the computer cursor in the same way a computer mouse is moved back



*The neurotrophic electrode shown here is the key development in a new system that could someday help paralyzed individuals communicate with the world around them.*

and forth. Indeed, the recorded neural signals substitute for the mouse cursor.

Unlike other electrode techniques that have been tried in the past—those primarily used miniature antennae that pierced the surface of the brain and usually lasted for only short periods—this electrode forms an intimate and long-lasting connection with the brain. This basic neurotrophic electrode technology was developed and patented by Dr. Kennedy while at the Georgia Institute of Technology. It was tested

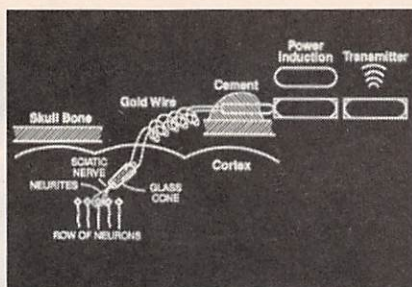


and developed using animals for over 12 years before it was implanted in humans. Both Federal Drug Administration and Institutional ethical approvals were obtained before the implants were made.

"The trick is teaching the patient to control the strength and pattern of the electric impulses being produced in the brain," Dr. Bakay said. "After some training, they are able to 'will' a cursor to move and then stop on a specific point on the computer screen."

**First Tests.** The electrodes have been successfully implanted into the brains of two patients at Emory University Hospital, one with amyotrophic lateral sclerosis (ALS or Lou Gehrig's disease) and one with a brainstem stroke. The first patient was able to control computer signals in an on/off manner for 76 days before she died from her terminal ALS condition.

The second patient, who is at the Atlanta Veterans Affairs Medical Center, is paralyzed except for his face due to a stroke and a subsequent heart attack. While dependent on a ventilator and unable to speak, he is fully alert and intelligent.



*As shown in this block diagram, the electrode, which is housed in a cone-shaped glass enclosure, is implanted into the cortex of the brain and brain cells are induced to grow onto its tip. Neurons transmit an electronic signal when they "fire." Gold recording wires pick up the neural signals and transmit them through the skull. The system is powered by an induction coil placed over the scalp.*

The electrodes were implanted in the part of the patient's brain that once controlled his arm and facial motion. All he has to do is think about moving his arm to create the electrical signals that are translated by the computer into movement of the cursor from icon to icon in a horizontal direction. As each icon is encountered, a phrase such as "See you later. Nice talking with you." is spoken by the computer.

The researchers are now working to help the patient communicate with the computer to produce

speech, as well as provide word processing, control of his environment, and maybe even access the internet. The future includes implanting the electrode in the brains of other "locked-in" patients.

**Other Applications.** The brain-implant technology has other applications. For instance, it could be used as a "spinal bypass" for those with spinal cord injuries that left them with stiff and uncontrollable muscles. Here neural signals could provide some control of electrical stimulators that activate the paralyzed muscles, therefore bypassing the area of spinal-cord injury.

The technique can also be used for basic research on understanding how the brain works. Never before have recordings been made from a human brain for so long and with such stability. For example, the firings of recorded neurons may change in response to differing inputs from different body parts: If neurons fire with taps to the arm, their firing may change over time from repeated taps to the face. This will help researchers understand how the brain communicates with other parts of the body.  $\Omega$

## RF POWER

(continued from page 54)

Road, Cleveland, OH, 44139; Tel: 1-440-248-1200) *Model 43 Thruline* meter. It's a tough old war horse! That instrument is an in-line meter that uses a plug-in directional coupler and detector element to customize the meter for different RF power levels and frequency ranges. The tip of the plug-in element comes in close proximity to the coaxial line that runs inside the meter case from connector-to-connector. The analog meter displays the value of the RF power being measured.

The case of the *Model 43* has two sockets for additional plug-in elements to accommodate other power and frequency ranges. The heavy leather case that protects the meter in transit has space for several more elements. I have ele-

ments for amateur radio HF (10 watts for QRP, 100 watts for my transceiver, and 1000 watts for my linear amplifier), amateur radio VHF (50 watts), and lower power VHF (for marine radios).

Notice in Fig. 9 that the element has an arrow on it. The arrow points in the direction of power measurement. For example, if the load is connected to the right-hand coaxial connector, and the transmitter is connected to the left-hand coaxial connector, then the meter (as shown) will measure the forward power. If the direction of the arrow is reversed, then the reflected power can be measured. Once both the forward power ( $P_F$ ) and reflected power ( $P_R$ ) are known, the SWR can be calculated; but to make things easy, the *Model 43* comes with a nomograph in the instruction book that makes the calculation graphically.

The Bird *APM-16 Advance Power Meter*, shown at the beginning of this article, is similar in concept to the older *Model 43*, but is considerably advanced. While the *Model 43* measures rms CW power, the *APM-16* will measure analog and digital complex waveforms, as well as CW (e.g. CDMA, TDMA, FDMA, COFDM and other modulation). It will measure both peak and rms power levels.

Figure 10 shows a Bird meter that uses a different approach. That meter uses a remote sensor head connected in-line between the source and load, and a multi-range digital readout display.

That wraps up our look at RF power-measurement circuits and instruments. Whether you need to measure RF power as part of your hobby or for your profession, keep the concepts we've discussed here in mind and you won't go wrong.  $\Omega$



# AC and DC Lamp-Dimmer Circuits, and More

**T**HE WEB SURE MAKES ELECTRONICS DESIGN MUCH SIMPLER AND FAR EASIER THAN BEFORE. FOR EXAMPLE, WWW.QUESTLINK.COM CAN ALMOST INSTANTLY PROVIDE YOU WITH ANY AVAILABLE DATA SHEET OR APPLICATIONS NOTE ON

just about anything from anyone. There are also a number of newsgroups that anyone into electronics will find handy, including:

- sci.electronics.design
- sci.electronics.equipment
- sci.electronics.misc
- sci.electronics.repair

I have recently added several more key electrical engineering links to my [www.tinaja.com/eeweb01.html](http://www.tinaja.com/eeweb01.html)

## Lamp Dimming Fundamentals

Let's assume you have some lamps that you want to cheaply control with a PC, a PIC, or another microprocessor: How would you go about it?

We saw last November (MUSE129, PDF on my Web site) how theaters and concerts use the fancy DMX512 communications standard. Also see RESBN76.PDF on my Web site for information on how home automation often makes use of X-10 dimmer controllers.

Anyway, any incandescent lamp might be brightened or dimmed by changing the DC or rms voltage sent to it. The obvious method involves putting a variable resistor in series with your light. Unfortunately, that technique has big-time inefficiency and heat problems. When you control a 100-watt bulb, as much as 25 watts of heat would have to

be burned up in the series controller.

One ancient alternative is to use a Variac, or variable AC transformer. In those, a knob twists a contact to select a changing turns ratio. Early theater lighting controls used ganged banks of motor-driven Variacs.

Incandescent lamps can be better brightened or dimmed by changing a duty cycle—the percentage of time voltage is applied. Duty cycling can be very efficient, since the controller is always either on or off. The ratio of on time to off time helps set the brightness. The switching frequency is usually 120-hertz or higher. The thermal inertia from the light bulb's filament and human persistence of vision should integrate or “average out” on and off times, reducing or eliminating flicker.

Your approaches to lamp dimming will differ between AC and DC power systems. The DC routes of Fig. 1 could be used in automobiles, for caving helmets, or in flashlights. In Fig. 1A, a

power semiconductor such as a MOS field-effect transistor is placed between lamp and ground. The lamp turns on by making the gate positive by five volts or so. It will turn off by leaving the gate voltage near ground. Very little gate current is needed, so the MOS device acts as a powerful linear or switched “amplifier.” One source of white LED caving lights that use those techniques can be found at [www.hdssystems.com](http://www.hdssystems.com)

In Fig. 1B, a newer style of integrated circuit known as a high-side driver is used. A high-side driver is basically a series power MOSFET with some additional control circuitry. The high-side driving eliminates the need for more than one wire going to the lamp. The return path can be via the vehicle frame or chassis. High-side driver circuits also sense open bulbs, detect other faults, and shut down on short-circuit currents.

One-piece chips that can combine dimming and high-side driving are available. Figure 1C shows how to use the new SGS-Thomson L9830. Its intended use is dimming dashboard lights in an instrument cluster.

The AC dimmers of Fig. 2 all provide a way to switch line-voltage bipolar currents that can be positive or negative. This leaves most power semiconductors out; the exception is a very popular switching device called a Triac.

A Triac has three terminals, called gate, T1, and T2. There is no current between T1 and T2 until a brief and small gate-current pulse is delivered. At that time, the Triac turns on and heavily conducts between T1 and T2. Above a rather small load-holding current, the Triac will latch and stay on. The Triac will stay on until such time as the main current returns to zero. Turn off will usually occur at the next current zero

## NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster  
Synergetics  
Box 809-EN  
Thatcher AZ, 85552  
Tel: 520-428-4073

US email: [don@tinaja.com](mailto:don@tinaja.com)  
Web page: <http://www.tinaja.com>



## new from DON LANCASTER

### ACTIVE FILTER COOKBOOK

The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. **\$28.50**

### RESEARCH INFOPACKS

Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See [www.tinaja.com/info01](http://www.tinaja.com/info01) for specifics. **\$79.00**

### CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. **\$28.50** each.

### INCREDIBLE SECRET MONEY MACHINE II

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. **\$18.50**

### LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. **\$119.50**

### LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

### BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. **\$39.50**

### THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. **\$28.50**

### BLATANT OPPORTUNIST I

The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. **\$24.50**

### RESOURCE BIN I

A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. **\$24.50**

### FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants. email: [don@tinaja.com](mailto:don@tinaja.com)  
FREE US VOICE HELPLINE VISA/MC

**SYNERGETICS**  
Box 809-EN  
Thatcher, AZ 85552  
(520) 428-4073

FREE catalog: <http://www.tinaja.com>

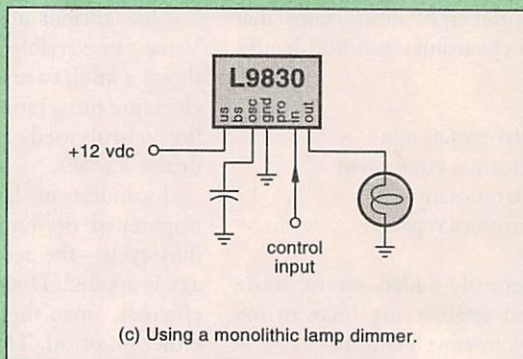
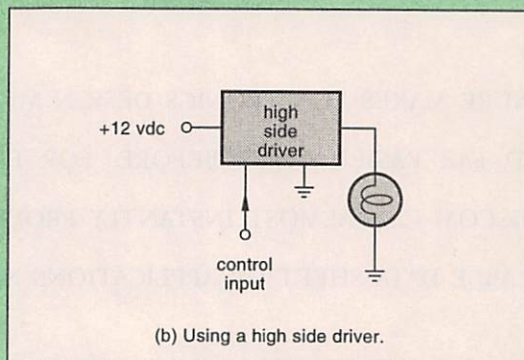
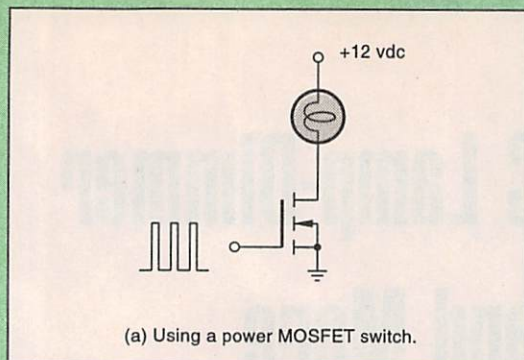


FIG. 1—THREE DIFFERENT APPROACHES to dimming a DC lamp.

crossing of the line AC sine wave.

The simple Triac on-off switching circuit appears in Fig 2A. Closing the switch turns the Triac on; opening the switch will turn the Triac back off just after the next zero crossing. The sensitivity of a Triac's gate changes a little with the changing line and gate polarity. But proper gate drive can switch either polarity load with either polarity gate pulse.

Your classic Triac wall dimmer is shown in Fig. 2B. The diac shown is a bilateral switching diode. A diac turns on whenever its lead voltage exceeds a set amount—often 30 volts or so. Each AC half cycle, the potentiometer starts charging the capacitor. When the capacitor reaches the threshold voltage, the diac will turn on, in turn tripping the main Triac.

The lower the potentiometer's resistance, the earlier in the half cycle that turn on occurs, and the brighter the lamp. The higher the resistance, the later in the cycle that turn on occurs, and the dimmer the lamp. Such a circuit is called a proportional phase control. A second resistor and capacitor (not shown here) will often be added to eliminate any "jumping" problems at very low light levels. You can see the waveforms on this in MUSE108.PDF on my Web site.

One big "gotcha" with Triacs is that they are connected to one side of the AC power line, which creates serious "hot chassis" shock-safety issues.

Figure 2C shows us the standard and safe way of interfacing a Triac to a PIC or a personal computer port. A small and low cost photo-Triac—an optoisolator



with a Triac output—is used. That device is just a light-emitting diode that shines onto a photo-Triac. Pulse the LED with suitably limited current (typically 10 mA) and both the little Triac inside the device and the big main one it drives turn on.

There are a few different ways to use this circuit: You can simply use it for on-off control. Alternately, for heaters and such, you can sense power-line zero crossings somehow and then provide turn on only just after a zero crossing. Such a zero-voltage switch eliminates annoying clicks and radio noise, and it is gentler on both the power line and your load. But note that zero crossing switching is not usable for dimming because the frequency is too low; flicker would be unacceptable.

Instead, you have the option of carefully pulsing the optoisolator's LED on at an exact position inside of each AC half cycle, thus creating a proportional phase control. This gives you a wide flicker-free brightness range.

You can also get combination Triacs and optoisolators. These are called AC solid-state relays and are offered in a wide variety, but tend to be more expensive than going with discrete devices.

A PIC or PC port can also be programmed to do fancy tricks such as slow dimming, stepped brightness, random "somebody is home" security lights, or for theater-lighting scene sequences.

Note that the brightness versus duty cycle is not linear. Why? Because there is more energy at a half sine-wave peak than at the "corners". Table lookup software can easily adjust for linear voltage versus current, linear power versus current, log compression for input audio, or can even create flickering "flame" effects. You can find more on those concepts on [www.tinaja.com](http://www.tinaja.com); look for EMERGOP5.PDF and MUSE109.PDF.

Be sure to observe the "backwards" LED connection. Because many computer ports and interface drivers are a lot better at sinking current than they are at sourcing, an active-low scheme is normally used; that turns the LED and the Triac on with a low input and off with a high input—watch that detail.

A Triac that switches in mid cycle could generate severe radio noise and other interference. Series LC filters and suitable shielding is often needed to keep that to acceptable levels.

The leading Triac and optoisolators

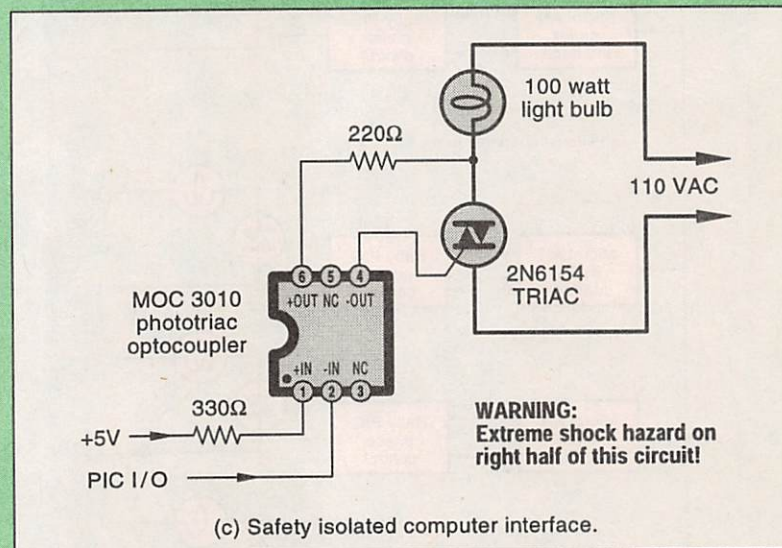
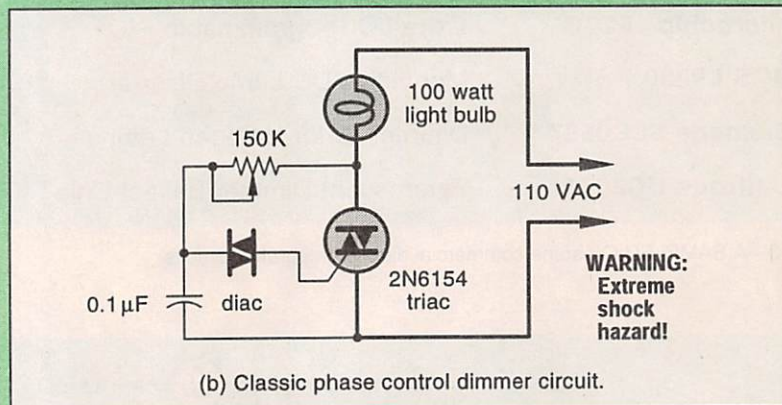
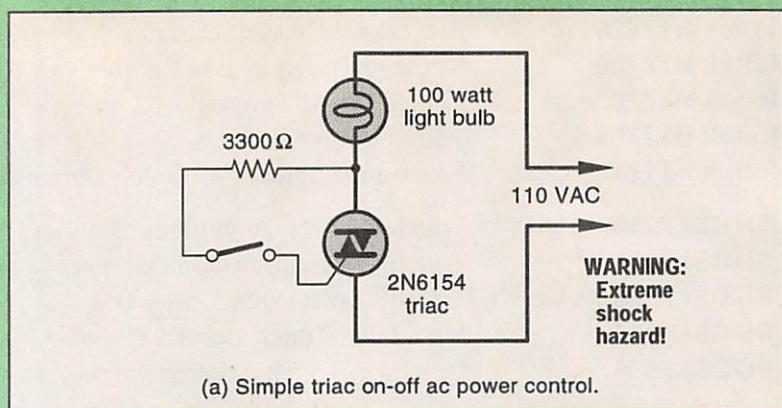


FIG. 2—THREE DIFFERENT line-operated lamp dimming circuits. All are built around a Triac.

manufacturers include Motorola, Teccor, and Texas Instruments. A color organ is an older name for psychedelic lighting or audio control of lamps. Design tips and ideas can be found in MUSE108.PDF on my Web site.

### A Selection of Dimmer Chips

You have a choice of building up a dimmer from bits and pieces, by use of a

PIC or other microcontroller, or by going to new specialized dimmer chips. A surprising variety of custom chips are available and are summarized in Fig. 3.

Two companies that seem to be in the dimmer forefront are Holtek and LSI/CSI. The Basic Stamp from Parallax or the PIC or baby PIC from Microchip Technology are often superb choices. Control can be by way of an up



<b>Holtek HT7620</b>	<b>PIC Controller with Dimmer</b>
<b>Holtek HT7700</b>	<b>Key and Touch Linear Dimmer</b>
<b>Holtek HT7703</b>	<b>Touch Linear Dimmer</b>
<b>Holtek HT7704</b>	<b>Touch Dimmer</b>
<b>Holtek HT7712</b>	<b>Minimum Component Touch Dimmer</b>
<b>LSI/CSI 7234</b>	<b>Touch Control Continuous Dimmer</b>
<b>LSI/CSI 7237</b>	<b>Touch Control Stepped Dimmer</b>
<b>LSI/CSI 7338</b>	<b>Touch Control with Timed ON</b>
<b>LSI/CSI 7314</b>	<b>Multi-level Touch Control Dimmer</b>
<b>LSI/CSI 7534</b>	<b>Up-Down Touch Control Dimmer</b>
<b>Microchip 12C08</b>	<b>Low Cost Baby Programmable PIC</b>
<b>Microchip 16C70</b>	<b>Extra I/O Programmable PIC</b>
<b>SGS L9830</b>	<b>Monolithic DC Lamp Dimmer</b>
<b>Siemens SLB0587</b>	<b>Dimmer IC for Halogen Lamps</b>
<b>Unitrode UC3871</b>	<b>Fluorescent Dimmer Ballast Chip</b>

FIG. 3—A SAMPLER OF some commercial dimmer integrated circuits.

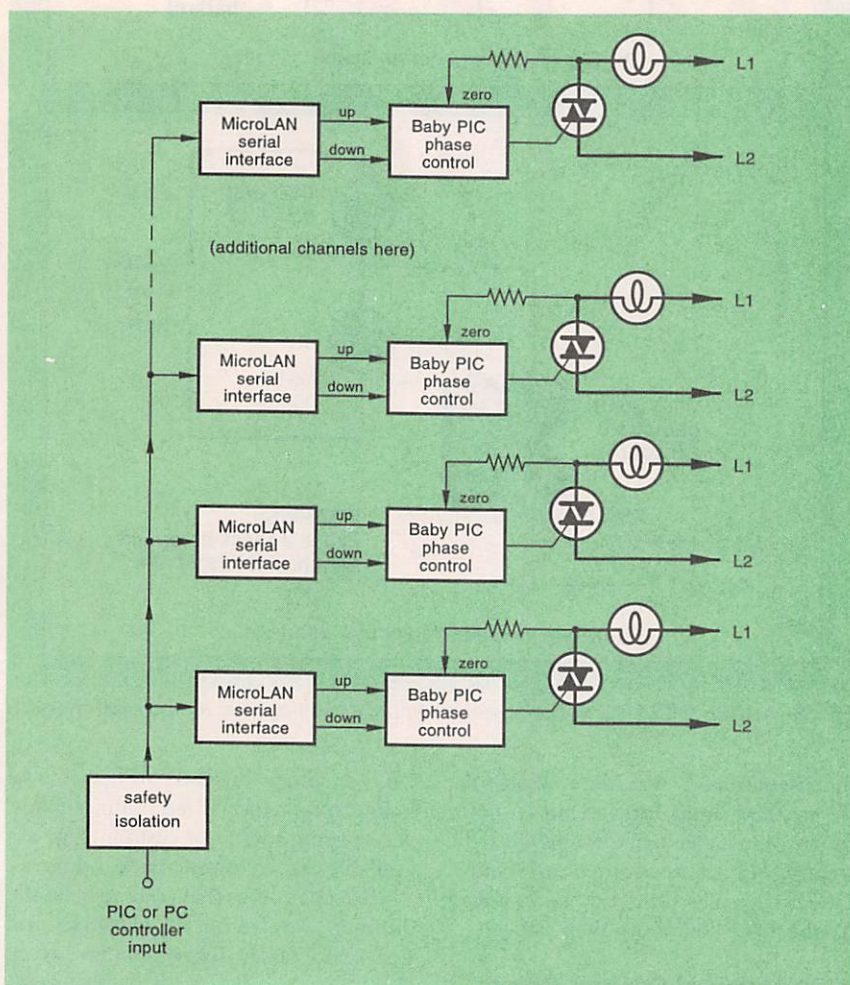


FIG. 4—ONE POSSIBLE SCHEME to remotely dim many lamps using only a single inter-connecting wire.

and down pair of input pins, by a resistor going to an A/D converter, parallel "set level" inputs, serial data, or an analog voltage.

A number of useful PIC-dimmer applications notes are downloadable directly from Microchip Technology. To download, use the Questlink listings or the links at [www.tinaja.com/picwb01.html](http://www.tinaja.com/picwb01.html)

One very interesting combination for multiple control of lots of lamps would be to drive a slew of up-down PICs with several of the new Dallas DS2407 dual addressable switches (from their MicroLAN series). That would let you cheaply and independently control dozens or even hundreds of lamps using a one-wire simple networking system. Each PIC would test every so often to decide if the brightness needed to be changed. With 64 brightness levels, the slew rate from full off to full on would be just over half a second with half cycle sampling if the elaborate MicroLAN comm scheme could be made fast enough. Each addressed up or down command would be carefully synchronized and adjusted to last for a precise line-cycle interval. Levels would be synchronized either with a master reset or simply by supplying enough down commands in a row to guarantee everything is off.

A possible block diagram for this appears in Fig. 4. Should the best data rates of a MicroLAN end up too slow, a second baby PIC might be used instead of turning to higher baud rates.

Even simpler might be a "one long serial word" setup. Your first six bits go to lamp 1, the second six bits go to lamp 2, and so on. Sort of a "mini" DMX512.

Yes, a PIC can directly drive a Triac gate. That would eliminate the cost of your Triac-output optoisolator. But the extreme shock hazard would have to be addressed at other points in your circuit or system.

Zero-crossing detection could be simplified by sensing only positive, zero-going transitions and deriving turn on pulses for both half cycles. For further consulting and design information, see [www.tinaja.com/info01.html](http://www.tinaja.com/info01.html)

### What About Fluorescents?

Fluorescent lamp-dimming needs special circuits. Ordinary dimmers must definitely not ever be used with fluorescents! But new concepts are available that let you dim from full brightness down to as low as four percent.



## NAMES & NUMBERS

**Advance Transformer**  
10275 W Higgins Rd.  
Rosemont, IL 60018  
(708) 390-5000

**Argonne National Lab**  
9700 S Cass Ave.  
Argonne, IL 60439  
(800) 627-2596

**Ark-Plas Products**  
Hwy 178 N  
Flippin, AR 72634  
(870) 453-2343

**Dallas Semiconductor**  
4401 Beltwood Pkwy. S  
Dallas, TX 75244  
(972) 450-0400

**Data Storage**  
10 Tara Blvd., 5th Fl  
Nashua, NH 03062  
(603) 891-0123

**Galco**  
26010 Pinehurst Dr.  
Madison Heights, MI 48071  
(800) 575-5549

**Holtek Technology**  
1342 Ridder Park Dr.  
San Jose, CA 95131  
(408) 573-8050

**Horizon MapInfo**  
3990 Ruffin Road  
San Diego, CA 92123  
(800) 828-2808

**Jameco Electronics**  
1355 Shoreway Rd.  
Belmont, CA 94002  
(800) 536-4316

**JKL Components**  
13343 Paxton St.  
Pacoima, CA 91331  
(800) 421-7244

**Levy/Latham**  
6263 N Scottsdale #371  
Scottsdale, AZ 85250  
(602) 367-1100

**Lindsay Publications**  
PO Box 538  
Bradley, IL 60915  
(815) 935-5353

**LSI/CSI Systems**  
1235 Walt Whitman Road  
Melville, NY 11747  
(516) 271-0400

**Map One**  
PO Box 999  
Dewey, AZ 86327  
(520) 632-8774

**Microchip Technology**  
2355 W Chandler Blvd.  
Chandler, AZ 85224  
(602) 786-7200

**Parallax**  
3805 Atherton Rd. #102  
Rocklin, CA 95765  
(916) 624-8333

**Planetary Society**  
65 N Catalina Ave.  
Pasadena, CA 91106  
(818) 793-5100

**SGS-Thomson**  
1000 E Bell Rd.  
Phoenix, AZ 85022  
(602) 867-6259

**Siemens Components**  
2191 Laurelwood Rd.  
Santa Clara, CA 95054  
(408) 980-4500

**Synergetics**  
Box 809  
Thatcher, AZ 85552  
(520) 428-4073

**Teccor Electronics**  
1801 Hurd Dr.  
Irving, TX 75038  
(214) 580-1515

**Unitrode**  
7 Continental Blvd.  
Merrimack, NH 03054  
(603) 424-8610

One source of suitable ballasts is Advance Transformer, while useful chips and applications notes can be found at Unitrode. Small laptop fluorescents and suitable dimming technique information is offered by JKL Components.

We just might look at fluorescent dimming further in a future column. Meanwhile, do not try it unless you really know what you are doing!

### Magnetic Recording Books

A list of magnetic recording books shows up for this month's resource sidebar. More information on any of these is

available at [www.tinaja.com/amlink01.html](http://www.tinaja.com/amlink01.html). A useful new trade journal on this topic is *Data Storage*.

Custom research into any technical field is available at surprisingly low cost at [www.tinaja.com/info01.html](http://www.tinaja.com/info01.html). This is especially useful in gathering essential broad-based primary and background material on any emerging or unfamiliar tech topic you might want to get into big time.

### Surplus Update

At present, the administrative expenses of selling military surplus elec-

tronics seem to be running something like \$1.60 for each dollar in public sales. Thus, your tax dollars are being used to pay people to haul away surplus bargains. Your best defense here is to recycle your tax dollars by grabbing some of these for yourself!

To improve their bottom line, the Feds appear to be experimenting with DRMO office closures; "term" sales (in which you agree to accept a full year's worth of stuff); other new types of sales; and privatization. An asset-management outfit by the name of Levy/Latham is now doing a few of the Fed's surplus sales—so far mostly big-ticket items like machinery and boats. Supposedly a lot more of this will be done in the future. For more details on getting involved, you can visit [www.levylatham.com](http://www.levylatham.com)

Although seldom advertised, most DRMO sites stock lists of people and firms who will photograph, bid, pack, and ship items for you. These lists are usually available on request. The type and quality of their services offered seems to vary with the base and who happens to live nearby. The major problem here is triage, where you literally will want to lighten up a lot before you ship.

A pair of tutorials on military-surplus bidding insider secrets can be found at [www.tinaja.com/resbn01.html](http://www.tinaja.com/resbn01.html). Hot buttons on my home page take you directly to the various DRMS access pages. Examples of the actual surplus bargains available these days are up at [www.tinaja.com/barg01.html](http://www.tinaja.com/barg01.html)

### New Tech Lit

You are invited to participate in a new SETI extraterrestrial intelligence search. An ongoing quest that needs zillions of net-linked computers. For info, see [setiathome.ssl.berkeley.edu](http://setiathome.ssl.berkeley.edu) or pick up the summary invitation in the October 30, 1998 issue of *Science*. Meanwhile, you also might follow the separate Planetary Society billion-channel extraterrestrial assay in real time at [seti.planetary.org](http://seti.planetary.org)

Volume 9, #4 of the *Tech Transfer Highlights* by the Argonne National Lab describes some magic new ionic conductor filters. One can be used to extract oxygen from air. Another can separate hydrogen from gas streams.

USGS topographic maps are at long last finding their way onto the Web and CD-ROM. Although not yet in full resolution, full quality, or in the zoomable and compact Adobe Acrobat format, at



## SOME MAGNETIC RECORDING BOOKS

*Complete Handbook of Magnetic Recording* (Finn Jorgensen)  
*Ferromagnetic Materials: Structure and Properties* (R. A. McCurie)  
*Ferromagnetism* (Richard Bozorth)  
*The Foundation of Magnetic Recording* (John Mallinson)  
*Handbook of Electromagnetic Materials* (Perambur Neelakanta)  
*Magnetic Disk Drive Technology: Heads...* (Kanu Ashar)  
*Magnetic Measurements Handbook* (J.M. Janicke)  
*Magnetic Storage Handbook* (Eric Daniel)  
*Magneto-Resistive Heads: Fundamentals...* (John Mallinson)  
*Modern Recording Techniques* (D. M. Huber)  
*The Physics of Magnetic Recording* (C.D. Mee)  
*Practical Recording Techniques* (Bruce Bartlett)  
*Theory of Magnetic Recording* (Neal Bertram)  
*Theory of Magnetism* (Kei Yosida)  
*Troubleshooting and Repairing Audio & Video...* (Homer Davidson)

least they are continuous without page breaks. One low cost CD-ROM source in my neighborhood is Map One found at [www.bslnet.com/map1](http://www.bslnet.com/map1) Included will be 64 seven-minute quads to TIFF quality, three reference maps, and a viewer for \$16!

MapInfo, a division of Horizons Technology, has a much more pricey new Web and CD-ROM-based service. Check their Web site at [www.horizons.com/suremaps](http://www.horizons.com/suremaps) These two are obviously the first two early tricklings of a deluge. I'd predict free viewing of USGS topographic maps routinely provided on hundreds of Web sites within a year or so, and snap-in GPS receiver modules within two.

From Jameco comes the latest electronic components catalog 984. Get this one free by clicking on their banner on my Web site. From Galco, their latest industrial electronics catalog. Galco specializes in high-power electronics.

Nomads, human-scale transport, and energy efficiency are all nicely covered by Steve Roberts through his Microship site at [www.microship.com](http://www.microship.com) Grab his free e-zine newsletter.

Free samples this month include a TLC5615 ten-bit serial D/A converter from Texas Instruments, along with plastic fittings, tubing, and such from the folks at Ark-Plas Products.

The latest of "new-old" books by Lindsay Publications now include the

*Harper's Aircraft Book, Manufacture of Wireless Components, and Electrical Designs.* All of these are unique turn-of-the-century reprints. *The Ultimate Modern Handbook* is a Cass Lewart book from Prentice Hall. More details on all these titles at [www.tinaja.com/amlink01.html](http://www.tinaja.com/amlink01.html)

For most individuals and smaller scale startups most of the time, any involvement with patents is virtually certain to result in a net loss of your time, energy, money, and sanity. Find out why, along with proven and tested real-world alternatives in my *Case Against Patents* package as per my nearby Synergetics ad.

The latest Web site additions at my [www.tinaja.com](http://www.tinaja.com) include an expanded PIC library, lots more classic Blatant Opportunist uploads, plus improved layout and navigation. The newest surplus bargains that you will now find at [www.tinaja.com/bargte01.html](http://www.tinaja.com/bargte01.html) include mystery cryogenics, military tube testers, distortion analyzers, superb luminance probes, radiosondes, and much more.

As usual, most of the mentioned resources show up in the Names & Numbers or the Magnetic Recording sidebars. Always check here before using our US technical helpline that is shown in the nearby box.

Let's hear from you.

EN

# NOW Find the Right Part for Your VCR!



The 172-page Eighth Edition of the VCR Cross Reference contains both model and part number cross references. Over 7,810 new parts and 1927 new models have been added.

VCR's are made in a few factories from which hundreds of different brand names and model numbers identify cosmetically-changed identical and near-identical manufactured units. Interchangeable parts are very common. An exact replacement part may be available only a few minutes away from you even though the original brand-name supplier is out of stock. Also, you may be able to cannibalize scrap units at no cost.

with  
the

## ISCET VCR CROSS REFERENCE

**NEW!** The Seventh Edition is contained on a 3½ diskette for IBM PC AT/XT compatibles, DOS 2.1 or higher. The disk software allows technicians to search by manufacturer for model numbers and description of part numbers. A parts editing sequence gives an on-screen view of all substitutes for parts entered. With the diskette, the technician can update files by adding model and parts

crosses of future models. The Eighth Edition can be printed on pages completely from the diskette.

The ISCET VCR Cross Reference, Seventh Edition, is on 8½ × 11-in., pre-punched pages and sells for \$24.95. The 3½ inch diskette sells for \$69.95 and you can view listings from a monitor or printed page.

**ONLY \$24.95 for pages  
\$69.95 diskette**  
Not including Shipping & Handling

Clagg Inc.  
VCR CROSS REFERENCE OFFER  
P.O. Box 4099  
Farmingdale, New York 11735-0793

Name \_\_\_\_\_  
Business \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_  
State \_\_\_\_\_ Zip \_\_\_\_\_  
Phone \_\_\_\_\_

Enclosed \$24.95 for the ISCET VCR Cross Reference, Eighth Edition.

Enclosed \$69.95 for the diskette containing the ISCET VCR Cross Reference, Ver. 7.0

Include \$5.00 for shipping Version 8 pages within the United States. All other countries add \$6.00 (surface mail).

Include \$3.00 for shipping Version 7 disk within the United States. All other countries add \$4.00 (surface mail).

The total amount of my order is \$ \_\_\_\_\_

Check enclosed—do not send cash. US funds only.

☐ Visa ☐ MasterCard Exp. Date \_\_\_\_/\_\_\_\_/\_\_\_\_

Card No. \_\_\_\_\_

Signature \_\_\_\_\_

New York State residents must add applicable local sales tax to total.

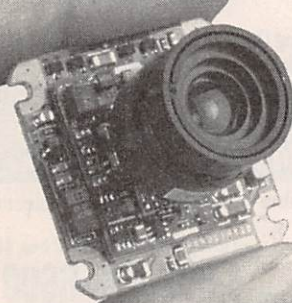
CB02



# Electronic SHOPPER

SUPPLEMENT TO ELECTRONICS NOW MARCH 1999

## Micro Video Camera Sale



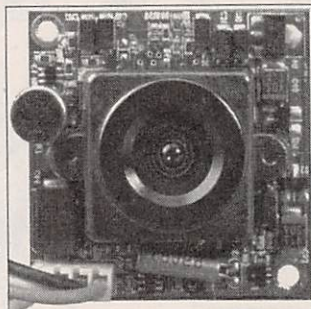
**MB-45cB**  
Color Video Camera  
2.8mm Lens  
45° Angle of View  
**\$99.95**

Size: 1.25" sq.



**MB-650Ua**  
Black & White Video  
Camera with Built-In  
Audio & 4.3 mm Lens.  
**\$89.95**

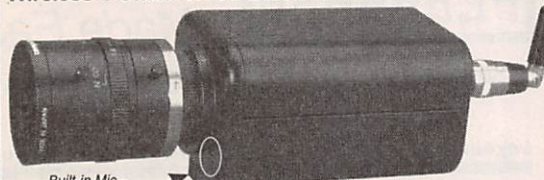
Size: 1.18" sq.



## Wireless Cameras

Wireless Camera Package Deals, include: one camera, one receiver and power supplies. (Receiver holds up to 4 cameras)

Wireless 4-Channel A/V Black/White & Color Cameras



Built-in Mic  
(on All models)  
Cameras are shipped with 4.3mm lens.  
(Camera shown with optional lens.)

**GFS-1001 (900MHz)**  
**GFS-2002 (1.2Ghz)**

## Wireless Transmitter & Receiver

**2.4 GHz**

Video/Stereo Audio

**ONLY \$219.95**



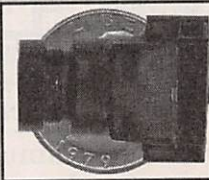
Dimensions: 2.5"(W) x 2.18"(H) x 3.28"(D)

## World's Smallest Video Camera

No Bigger than the  
size of a Quarter!  
with CMOS Technology.

CM-550U - \$69.95  
Pinhole Camera Available:  
CM-550P - \$69.95

240 Line Horizontal Resolution  
Size: 1.12"(L) .5"(W)



## Micro Audio Receiver



• Audio Jack - RCA Female.  
• Power Jack - 2.1 Female Barrel Jack.

**MIC-300 - \$39.95**

## Video Conferencing

TeleEye has everything you need to do Color Video Conferencing. It comes with a built-in high quality digital camera, a high speed modem and state-of-the-art Audio/Video hardware.

Remote View Window  
Up to 15 frames per second  
or VHS-quality resolution.

On-Screen Menus  
Easy Control using your  
phone keypad.

**\$499.<sup>95</sup>**  
Stand Alone System  
No PC Needed.



**FREE**  
Polaris Product Catalogs

**LP-850p**  
**\$139.95**



Length: 1.37"  
Diameter: .87"

**Outdoor Model Available**  
**\$169.95**

**LP-850i**  
**\$129.95**



Length: 1.9"  
Diameter: .91"



**Polaris Industries**  
<http://www.polarisusa.com>  
**800.752.3571**

Polaris Industries 470 Armour Dr. Atlanta GA 30324 Tech Info: 404.872.0722 FAX: 404.872.1038



**SCO-1 - \$399.95**  
Observation System

Interfaces with existing  
Camera Systems!

**System includes:**  
• Monitor  
• Camera/100 ft. Cable  
• Camera Stand/Mount  
• 2-way Intercom Station  
• 100 ft. Intercom Cable  
• VCR/Interconnect Cable  
• One Year Warranty

**SCO-1 - \$399.95**  
Observation System

March 1999, Electronics Now



# EARN MORE MONEY!

## Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

**No Need to Quit Your Job or Go To School**  
This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 210

### COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 210  
P.O. Box 2824, San Francisco, CA 94126  
Please rush FREE details immediately!

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

## Digital Power Meter



Measures  
Watts  
& Watt-hours  
(kW-hr)

Simple to use.  
Plug the Power Meter  
into any AC outlet, and plug the  
appliance to be measured into the  
Power Meter. That's it!

### Model 4-1850:

- Measure REAL ("true") power  
1 to 1850 Watts
- Measure Power used, 1 Watt-hour  
to 9999 kilo-Watt-hr
- Measure power cost (\$), just enter  
cost per kilo-Watt-hr

**New! RS-232 Interface**  
features data logging, on-  
screen measurement, display  
and analysis. Can be added  
to either model, only \$50!

Model 20-1850 does everything the 4-1850 with these additional  
features: Irms, Vrms, Power Factor, 20 mhz processor and more!

Model 4-1850 Only \$149.<sup>95</sup> Delivered!

Model 20-1850 Only \$249.<sup>95</sup> MC/Visa/MO/Check

Custom applications available • Dealer inquiries welcome

Brand Electronics,  
421 Hilton Rd.  
Whitefield, ME 04363

For information only, call 1-207-549-3401  
email: ebrand@mint.net

Call today! To order, call toll free, 24 Hrs.

**1-888-433-6600**

<http://www.mint.net/~ebrand/>

## PCBoards

## PCB Artwork Made Easy!

### PRINTED CIRCUIT DESIGN SOFTWARE

For Windows and DOS

Layout - Autorouting - Schematic - Circuit Simulation

- \* 16 and 32 bit version available
- \* Ripup and Retry Router in Advanced Pkg.
- \* Copper Flooding for Building Ground Areas
- \* Gerber and Excellon Output
- \* Create Negative & Positive Printouts
- \* Create Single or Multi Layer Boards
- \* Create artwork from the Schematic
- \* Analog and Digital Simulation available
- \* Make boards up to 32" x 32"
- \* Parts Libraries - Silk Layers - Solder Mask
- \* For the Professional and Hobbyist!

Download DEMO - [www.pcboards.net](http://www.pcboards.net)

Windows LAYOUT pgm. starts at

**\$149**

Windows Pkg. layout-schematic-router

**\$399**

DOS pcb layout - \$49.95

Call or Write for Full Product Line, Prices & Free Demo

PCBoards

(800)473-7227

2110 14th Ave. South  
Birmingham, AL 35205

Fax (205)933-2954  
Phone (205)933-1122



# RAMSEY



## World's Smallest TV Transmitters

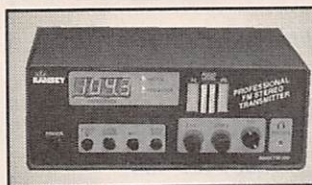
We call them the 'Cubes'... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies—that's a nickel in the picture!



Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals low enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

- C-2000, Basic Video Transmitter Cube.....\$89.95
- C-3000, Basic Video and Audio Transmitter Cube.....\$149.95
- C-2001, High Power Video Transmitter Cube.....\$179.95
- C-3001, High Power Video and Audio Transmitter Cube.....\$229.95

## Super Pro FM Stereo Radio Transmitter



A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require

a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

- FM-100, Professional FM Stereo Transmitter Kit.....\$299.95
- FM-100WT, Fully Wired High Power FM Transmitter.....\$429.95

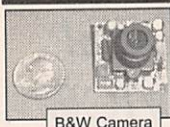
## AM Band Radio Transmitter



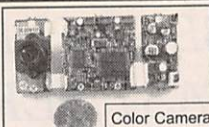
Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper settable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

- AM-25, Professional AM Transmitter Kit.....\$129.95
- AM-1, Entry level AM Radio Transmitter Kit.....\$29.95
- CA1, Matching Case Set for AM-1.....\$14.95

## CCD Video Cameras



B&W Camera



Color Camera

If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays with over 440 line line resolution, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. Also, a new strain of CMOS single chip cameras are entering the market, those units have about 1/2 the resolution and draw over twice the current that these cameras do - don't be fooled! Our cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, the black & white models are super IR (Infra-Red) sensitive. Our IR-1 Illuminator kit is invisible to the human eye, but lights the scene like a flashlight at night! Color camera has Auto White Balance, Auto Gain, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. They run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our IB-1 Interface board for audio sound pick-up and super easy direct wire hook-up connection to any Video monitor, VCR or TV with video/audio input jacks. Cameras fully assembled, including pre-wired connector.

- CCDWA-2, B&W CCD Camera, wide-angle lens.....\$99.95
- CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.....\$99.95
- CCDPH-2, Color CCD Camera, wide-angle lens.....\$149.95
- IR-1, IR Illuminator Kit for B&W cameras.....\$24.95
- IB-1, Interface Board Kit.....\$24.95

## FM Stereo Radio Transmitters



Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

- FM-25, Synthesized FM Stereo Transmitter Kit.....\$129.95

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice finished look.



- FM-10A, Tunable FM Stereo Transmitter Kit.....\$34.95
- CFM, Matching Case and Antenna Set.....\$14.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

## RF Power Booster

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat, professionally finished look, add the optional matching case set.

- LPA-1, Power Booster Amplifier Kit.....\$39.95
- CLPA, Matching Case Set for LPA-1 Kit.....\$14.95
- LPA-1WT, Fully Wired LPA-1 with Case.....\$99.95

## Treasure Finder Kit



Search for buried treasure at the beach, backyard or park. This professional quality kit can detect metal at a depth of up to 6 inches. Easy to use, just listen for the change in tone as you 'sweep' the unit across the surface - the larger the tone change - the larger the object.

Has built-in speaker or earphone connection, runs on standard 9 volt battery. Complete kit includes handsome case, rugged PVC handle assembly that 'breaks down' for easy transportation and shielded Faraday search coil. Easy one evening assembly. This nifty kit will literally pay for itself! That guy in the picture looks like he found something - what do you think it is - gold, silver, Rogaine, Viagra? You'll have fun with this kit.

- TF-1, Treasure Finder Kit.....\$39.95

## Binocular Special

We came across these nice binoculars in an importers close-out deal. Not some cheap in-line lens jobs, these beauties have roof prisms, a super nice rubber armored housing over light weight aluminum. 10 x 25 power with fully coated optics. Includes lens cleaner cloth, neck lanyard and nice carry case. For extra demanding use in bright sun, choose the EX module with ruby coated Objective lens. First quality at a close-out price! We've seen the exact same units with the 'Bushnell' name on them being sold for \$30 more!



- BNO-1, Binoculars and case.....\$24.95
- BNO-1EX, Ruby Coated Lens Binoculars and case.....\$29.95

## Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems, hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.



- SS-70A, Speech Descrambler/Scrambler Kit.....\$39.95
- SSS, Custom Matching Case and Knob Set.....\$14.95
- SS-70AWT, Fully Wired SS-70A with Case.....\$79.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

## Call for our Free Catalog!

See our complete catalog and order on-line with our secure server at:  
[www.ramseyelectronics.com](http://www.ramseyelectronics.com)

## RAMSEY ELECTRONICS, INC.

793 Canning Parkway Victor, NY 14564

## Order Toll-free: 800-446-2295

Sorry, no tech info, order status at this number

## Technical Info, Order Status

Call Factory direct: 716-924-4560

Fax: 716-924-4555



ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

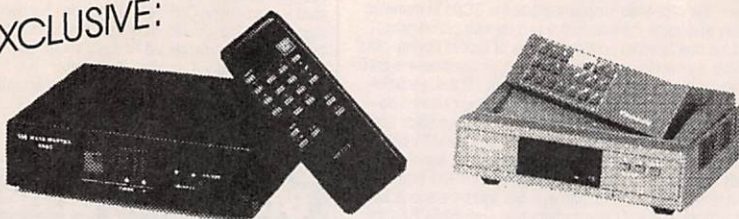


**ATTENTION DEALERS: WHOLESALE ONLY!**



**BEST PRICES!  
FAST SERVICE  
SAME DAY SHIPPING**

**EXCLUSIVE:**



**2 PIECE SETUPS: \$85<sup>00</sup>**

10 lot • 1 Year Warranty

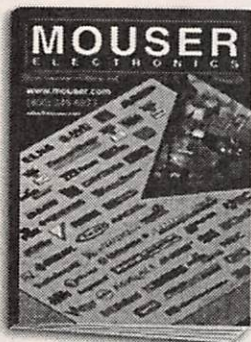
**Latest Technology • Universal Combo's - Ask For Details  
CALL US LAST! LOWEST PRICES GUARANTEED!**

**TOLL FREE:  
800-375-3682**



**FAX:  
516-246-5634**

**ELECTRONIC COMPONENTS**



**Visit our web site!  
www.mouser.com**

Subscribe, download, or  
view catalog online!

- Over 78,000 Products
- More than 145 Suppliers
- Same Day Shipping
- No Minimum Order

**800-992-9943**

817-483-6828 Fax: 817-483-6899  
catalog@mouser.com

958 North Main St., Mansfield, TX 76063

**BEST DEALER PRICING!  
CABLE  
DIRECT  
CONVERTERS • FILTERS  
DESCRAMBLERS**

**IMPROVE YOUR IMAGE WITH  
VIDEO STABILIZERS**

**FREE  
CABLE TV  
CATALOG!**

**100%  
MONEY BACK  
GUARANTEE!**

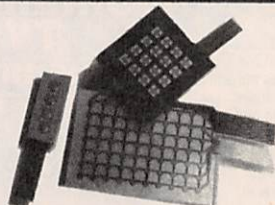
Now you can tune-in your favorite  
cable TV programming  
and **SAVE \$100'S -  
EVEN \$1000'S** on premium  
CABLE TV EQUIPMENT.



**MODERN  
ELECTRONICS  
1-800-906-6664**

2609 S. 156TH CIRCLE • OMAHA, NE 68130  
http://www.modernelectronics.com

## MEMBRANE SWITCHES



**Stock Layouts!**

**Eliminates tooling  
cost...**

**\*\*From 2 to 128 keys\*\***

**Industrial/Commercial/  
Prototyping**

Popular types are available as  
complete **kits**, with bezel,  
connector & overlay!

4 key DSK-4 kit \$9.60

12 key DSK-12 kit \$13.87

many more layouts...

**Optional Stainless Steel  
"Clickdomes".**

**Sil-Walker**

(805) 491-0654

FAX (805) 491-2212

P.O. Box 3220

Camarillo, CA 93011-3220

silwkr@vcnet.com

www.vcnet.com/silwkr/

**MASTERCARD/VISA**

## Low Cost PICmicro Tools



**EPIC Pocket PIC Programmer - \$59.95**

❖ Programs PIC12C50x, 67x, 16C55x, 6x, 7x, 8x

**PICProto Boards - \$8.95 to \$17.95**

**PicBasic Compiler - \$99.95**

**new! PicBasic Pro Compiler - \$249.95**

BASIC makes it easy for you to program the  
fast and powerful Microchip PIC microcontrollers.

❖ Expanded BS1/2 compatible instruction set

❖ True compiler provides faster program execution  
and longer programs than BASIC interpreters

**microEngineering Labs, Inc.**

Box 7532 Colorado Springs CO 80933

(719) 520-5323 fax (719) 520-1867

http://www.melabs.com



# ALL ELECTRONICS

C O R P O R A T I O N

QUALITY  
PARTS

FAST  
SHIPPING

DISCOUNT  
PRICING

CALL, WRITE, FAX  
or E-MAIL For A  
**Free 96 Page**  
CATALOG.  
Outside the U.S.A.  
send \$3.00 postage.

## Interact ProPad GAME CONTROLLER

Interact Game Products # SV-230  
PC ProPad works with hundreds of  
PC games. Very similar to  
Super Nintendo  
controllers, it has a  
four-way direction but-  
ton on the left, A and B  
buttons on the right and speed con-  
trols and auto-fire controls in  
the middle. 15 pin D-sub con-  
nector plugs into the sound  
card on most Windows based computers.



**\$3.00**  
each

CAT # SV-230

2 for \$5.00

## 3000 MCD ULTRA-BRIGHT RED LED

Everlight # 383URC-2/TR1-C(R)  
Red, "Ultra-bright" T 1 3/4 LEDs  
now at our lowest price ever.  
Due to a special purchase of  
"tape-and-reel" parts we are  
able to offer these LEDs at an  
incredibly low price when pur-  
chased on the reel. These  
are 5 mm diameter water-clear LEDs that  
light bright red at 20 ma.



CAT# LED-50

**2 for \$1.00**

100 for \$35.00  
1000 for \$250.00  
(25¢ each)

## S-VHS Tape (Used)



Super VHS tape users!  
Save a bundle on  
name-brand S-VHS,  
T-120 tapes. These  
tapes were used for a  
brief period, then bulk  
erased. The record-  
protect tabs have been broken  
out, so you will have to cover the  
notch with a piece of tape, but they work  
great and cost a fraction  
of the "new" price.

CAT #S-VHS

**\$3.00**  
each

10 for \$28.00 • 100 for \$250.00

## STEREO HEADSET with Electret Mike

Andrea Electronics # M-150  
Designed for use with  
personal computers for multi-  
media, speech recognition,  
internet telephone, etc.  
Stereo headset  
and boom mike  
has two separate  
3.5mm stereo  
plugs for connection  
to mike and speaker jacks.  
Lightweight headphones  
with adjustable headband.  
6' cord.



CAT# PHN-15

**\$8.75**  
each

## 10K THERMISTOR

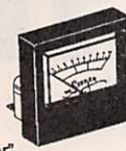
Semitec # 103AT-2  
10K ohm (± 1%) @ 25 deg. C. Rated  
10 mW. Time constant: 15 sec. 2 mm  
x 3mm. 2.5mm lead spacing. CAT #THR-20

**\$1.00**  
each

10 for \$8.50  
200 for \$130.00

## 250 uh PANEL METER

Good-looking 1.65" x 1.68"  
panel meter. Matte-black frame  
with a 1.43" x 0.84" viewing  
window. Scale calibrated from  
1 to 10, divided into green  
(1-4), yellow (4-6) and red  
(6-10) areas. Logo, "The Seeker"  
is written under the scale.



**\$1.50**  
each

CAT #MET-51  
10 for \$12.50

## Encased Piezoelectric Element

0.82" DIAMETER X 0.15"  
AVX/Kyocera # PCRT21BGX  
Black plastic front, vented metal  
back. Solder loop terminals. Louder than  
non encased piezo elements. Requires exter-  
nal signal to produce sound. CAT # PE-38



**3 for \$1.00**

100 for \$25.00  
1000 for \$125.00

## BIG Flashing LED

Big, bright red flashing LED.  
10 mm diameter. Red diffused lens.  
Great for attention getting displays.  
Operates on 3-12 Vdc. Flash rate  
approx. 2 times per second.

CAT# LED-60

**2 for \$1.50**

10 for \$6.50  
100 for \$50.00



## UV Blacklight

New black-light lamps designed by Avon  
Cosmetics to highlight dry skin.  
They have a built-in timer that  
shuts-off the lamp after  
approximately one  
minute. Ideal for  
lighting fluorescence  
in black-light  
posters, gemstones,  
hand stamps and US  
currency. 5" lamp, F4T5BLB, is housed in a  
lightweight plastic case. 7" x 3.25" x 2.3" high.  
Powered by a 12 Vdc, 500 ma wall transformer  
(included). Individually boxed.



CAT# UVL-1

**\$10.00**  
each

F4T5-BLB Replacement lamp for above  
fixture. CAT # BLB-5 \$3.00 each

## 470 Mfd 450 Vdc

Nichicon #LGQ2W471MHSC  
1.375" dia x 2" high. 0.4" lead  
spacing.

CAT# EC-4745

**\$3.00**  
each

10 for \$22.50



## "Hi-8" Video Cassette

SONY Hi-8 Top quality,  
metal particle 120 minute  
video cassettes. Used  
for a short time, then  
bulk-erased. Each  
cassette has its own  
plastic storage box.



CAT # VCU-8

**\$3.00**  
each

10 for \$28.00 • 100 for \$250.00

ORDER TOLL FREE

**1-800-826-5432**

MAIL ORDERS TO:  
**ALL ELECTRONICS CORP.**  
P.O. BOX 567  
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524  
INTERNET <http://www.allcorp.com/>  
E-MAIL [allcorp@allcorp.com](mailto:allcorp@allcorp.com)

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail •  
Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United  
States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

**MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.**





## INTERNET SECURITY

The latest tricks and methods hackers use on the Net to pirate software (warez), and hack websites. Includes examples, countermeasures, password defeats, Packet-Switched Networks, UNIX, Sprintnet, X.25, anonymous FTP, brute force techs, lots of tips. **More!** \$29. EWC=29.4K

**INTERNET TRACKING & TRACING:** Scammers, spammers, stalkers, infectors, and others hide behind the Internet's anonymity to commit serious offenses. Learn from master hackers best methods to track, trace IDs and origins, and to protect your own privacy. **More!** \$29. EWC=17.0K

**INTERNET FRAUDS DATABOOK:** Internet cons, scams and related frauds now rake in \$2+ Billion annually! Most are done anonymously with impunity. Details how they're done, how to ID them, how to protect yourself. **More!** \$25. EWC=18.9K

**THE COOKIE TERMINATOR:** Many websites track your every move! Browser cookie, history and cache files contain personal data readily accessible to Internet predators, scammers, spammers and snoops. Your financial, medical, political, habits, lifestyle, future plans data is exposed to the world! Step-by-step how to remove and stop cookies from destroying your privacy. **More!** \$25. EWC=8.4K

Any 2 for \$49, 3 for \$64, all 4 for \$79!

## PBX SECURITY

PBXs hacking losses of \$5-\$10 Billion/yr! Detailed vulnerabilities (especially for out-dial), countermeasures. Exclusive author interview in Forbes! \$24. EWC=17.4K

## ATM SECURITY

100+ ATM crimes, abuses, vulnerabilities, defeats exposed. TEMPEST, mag stripes, false fronts, supercool. **More!** Case histories, labeled internal photos, figures. \$39. EWC=41.0K

**TOP SECRET**

## CONSUMER ELECTRONICS

2430 Juan Tabo, NE, #259, ABQ, NM 87112

P.O. Box 23097 ABQ, NM 87192

Fax: 505-292-4078 (all hours, orders only) Voice: 505-237-2073 (9-7 M-S)

Full Web Catalog: [www.tsc-global.com](http://www.tsc-global.com)

Special Projects: [spaf-spp.html](http://spaf-spp.html)

Established in 1971 by John Williams, MSEE, former DOD weapons engineer and NIH physicist. Featured on CBS '60 Minutes', Forbes, New York Times. Add \$5 total S/H (US, Canada). Postal MO is fastest! VISA, MC OK. No CODs. 10% OFF all Orders over \$100; \$2.00 OFF all New Orders over \$20 placed by Mail or Fax. EWC=Estimated Word Count. Sold for legal educational purposes only. Some publications are controversial! We take no responsibility for anything we publish. See Catalog for LIMITED WARRANTY, SPECIAL PROJECTS and all other applicable policies.

## CELLPHONE/CORDLESS GUIDE

How cellphones operate; mods. Vulnerabilities to hack attack; countermeasures. Cloning details for NAMS, ESNs, etc. control data formats, computing encoded MINs, ESNs, SIDHs, Op Sys, PROMs, forcing ACK, test mode and resets, cable diagrams, scanning, tracking, scanner restorations, freq allocations, roaming, step-by-step to keypad-reprogram 100+ popular cellphones. One FREE database search. Plus much on Cordless phones. **More!** \$49. EWC=80.2K

**PAGER (BEEPER) MANUAL:** How Pagers work, different types and uses, freqs, advantages over and uses with cellphones, and tips and tricks. How phreaks hack Pagers; countermeasures. Plus plans for a Personal Pocket Paging System (xmitter and receiver). **More!** \$29. EWC=11.4K

Both for only \$69!

## CALLER ID & ANI SECURITY

How they work and the many vulnerabilities of Caller ID, ANI, \*69, \*57, Call Blocking, \*67, et al. Describes ESS, SS7, CN/A, CAMA, DNR, Diverters, Centrex! \$25. EWC=15.2K

## FAX MACHINE SECURITY

All known methods used to hack Faxes and countermeasures. Includes computer fax modems, crimes, interceptions, fax servers, fax-on-demand, protocols, parameters, compression, encryption, and fax surveillance-type mods. **More!** \$29. EWC=28.7K

## VOICE MAIL SECURITY

VMS are hacked to penetrate PBXs to make outgoing calls, get free VMB usage, secretly read/change/delete messages, control or damage the VMS (or its PBX) itself. Details how hackers do it, countermeasures. A must for users, sysops, security personnel! \$29. EWC=14.2K

CATALOG \$1 WITH ORDER, \$3 W/O

## STOPPING POWER METERS

As reported on "60 MINUTES"! 6th Edition! Details devices that can slow down (even stop) power meters while loads draw full power - great science projects! Devices plug into one outlet and normal loads into other outlets. Describes meter creep, overload droop, pole meters, etc. \$29. EWC=10.4K

**SPM THE VIDEO:** Now it's easier to learn about KW-HR Power Meters than ever before! This educational video shows you how they work and their anatomy. Demonstrates SPMEM device and external magnetic methods used to slow and stop meters! Hosted by a top expert in the field. From the novice to the pro, an excellent source of info on these exciting devices! Great in combo with our SPM-related manuals! \$29. (20 min)

**THE I.G. MANUAL:** Details external magnetic ways (applied to meters) outlaws use to slow down and stop power meters while drawing full loads. \$25. EWC=4.9K

**KW-HR METERS:** How watt-hour energy meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow, stop power meters by others. \$25. EWC=24.2K

Any 2 for \$49, 3 for \$64, all 4 for \$79!

## COMPUTER SECURITY

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ protection system. Internet advice, password defeats, glossary - much more! Manual + PC Disk! \$39. EWC=54.7K

**THE HACKER FILES:** Expose 3 HD PC disks filled with choice raw, colorful, highly informative hacker, phreaker text files covering many topics! \$39. Both for only \$69!

## BEYOND VAN ECK

Plans for remote eavesdropping of TV video signals. Range up to 1 KM. Describes how van Eck systems work, and are also used in surveillance of computer systems. \$29. EWC=10.6K. Van Eck Demo Tape is \$29. (15 min). Both for only \$49!

## MANY MORE TITLES!

(See Catalog for prices & descriptions)  
BEYOND PHONE COLOR BOXES  
ANSWER, MACHINE SECURITY  
CASINO SECRETS  
CHECK & M.O. SECURITY  
CREDIT CARD SECURITY  
CONS & SCAMS DATABOOK  
SOCIAL ENGINEERING  
POLYGRAPH SECRETS  
BY AN ORDER OF THE MAGNITUDE  
ULTIMATE SUCCESS MANUAL  
STEALTH TECHNOLOGY  
SIMPLE/CHEAP SECURITY ELEC.  
SECRET & SURVIVAL RADIO  
THE "GOLDFINGER"  
THE "SILKWORM"  
SECRETS OF SOLDERLESS BBS  
HIGH VOLTAGE DEVICES  
MIND CONTROL  
UNDER ATTACK!  
RADIONICS MANUAL  
HEAL THYSELF!  
SECRET & ALTERNATE IDS  
CRYPTANALYSIS TECHNIQUES  
GOVERNMENT LAND GRAB  
ROCKET'S RED GLARE  
SURVIVAL GUNS & AMMO  
THE ULTIMATE DRIVER

## THE DIRTY-2 DOZEN!

24+ Hot Hack/Phreak Expose Disks!  
See CATALOG!

## SPECIAL PROJECTS

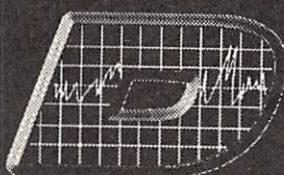
We will design & build just about anything electronic! Hardware done as SPECIAL PROJECTS. See Catalog for details and SP Application Form, else: [www.tsc-global.com/spaf-spp.html](http://www.tsc-global.com/spaf-spp.html)

Quality  
Reconditioned

# TEST EQUIPMENT

WANTED USED  
TEST EQUIPMENT

Visit us at our website  
[www.danbar.com](http://www.danbar.com)



**DANBAR**  
SALES COMPANY

Anritsu MS420K .....	\$3,500.00	Hewlett-Packard 3488A .Special	\$550.00
Anritsu ME538M .....	\$12,500.00	Hewlett-Packard 355C .....	\$150.00
Bird 4380A .....	\$300.00	Hewlett-Packard 355D .....	\$150.00
Bird 4410A .....	\$300.00	Hewlett-Packard 3575A .....	\$750.00
Bird 61 .....	\$175.00	Hewlett-Packard 3580A .....	\$900.00
Bird 611 .....	\$200.00	Hewlett-Packard 3586B .....	\$850.00
EIP 351C .....	Special \$800.00	Hewlett-Packard 435A . Special	\$275.00
EIP 451 .....	Special \$850.00	Hewlett-Packard 436A . Special	\$950.00
EIP 545 .....	Special \$750.00	Hewlett-Packard 438A .Special	\$3,250.00
EIP 545A .....	Special \$895.00	Hewlett-Packard 8350B .....	\$2,000.00
EIP 548 .....	Special \$2,500.00	Hewlett-Packard 83522A .....	\$4,250.00
EIP 548A .....	Special \$3,500.00	Hewlett-Packard 83525A .....	\$5,900.00
General Radio 1482B ..	Special \$250.00	Hewlett-Packard 83545A .....	\$3,900.00
Available in 1482D, E, F, L, J, K, M, P or Q		Hewlett-Packard 83590A .....	\$6,900.00
Hewlett-Packard 3312A .....	\$575.00	Hewlett-Packard 83592B .....	\$10,950.00
Hewlett-Packard 3325A .....	\$1,250.00	Hewlett-Packard 83594A .....	\$14,700.00
Hewlett-Packard 3336B .....	\$850.00	Hewlett-Packard 8770A .....	\$6,000.00
Hewlett-Packard 3336C .....	\$1,250.00	Tektronix 2213 .....	\$650.00
Hewlett-Packard 334A .....	\$395.00	Tektronix 2215 .....	\$750.00
Hewlett-Packard 339A .....	\$1,250.00	Tektronix 2235 .....	\$950.00
Hewlett-Packard 3455A .....	\$350.00	Tektronix 2465 .....	Special \$2,350.00
Hewlett-Packard 3456A .....	\$500.00	Tektronix 2465A .....	\$3,250.00

(602) 483-6202 • (602) 483-6403 Fax

14455 North 79th Street, Unit #C • Scottsdale, Arizona 85260

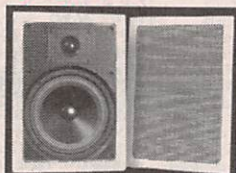


# PARTS EXPRESS

ELECTRONICS & MORE

## 6-1/2" Two Way System

This is our most popular in-wall. You won't believe how good these really sound. Big enough to produce great home theatre sound and still fit everyone's budget. Put a pair in every room of your house.



Great for front or rear speakers in your surround system. The 6-1/2" polypropylene woofer and 1" textile dome tweeter were specially designed with home theatre in mind. The crossover network utilizes a mylar capacitor for crisp clean highs. 3 piece design make installation in new or existing walls a snap.

**Specifications:** ♦6-1/2" polypropylene cone woofer with poly foam surround ♦1" textile dome tweeter/midrange ♦8 ohm impedance ♦3 component L/C crossover network ♦Frequency response: 50-20,000 Hz ♦Power handling capability: 60 watts RMS/85 watts max ♦Sensitivity: 89 dB 1W/1m ♦Overall dimensions: 8-1/2" W x 12" L x 3-1/2" D ♦Hole size: 7-1/4" x 10-3/4" ♦Fits into standard 2" x 4" wall ♦Net weight: 12 lbs. per pair.

#300-036 ..... \$89.90 (1-3 PRS) \$79.50 (4 PRS-UP)

## Satellite Speaker Stands

These quality speaker stands are perfect for mini or rear surround speakers. The heavy die cast base provides stability. Textured black satin finish blends in well with any decor. The height is adjustable from 26-1/2" to 47-1/2" and the speaker wire can be run inside the pole for a better appearance. The top base is adjustable from 4-1/8" to 7-1/2" to accommodate most mini speakers. Includes foam pads to prevent marring of speaker cabinet. Sold in pairs. Net weight: 12 lbs.



#240-762 ..... \$39.80 (1-3 PRS) \$35.50 (4 PRS-UP)

## 5 Function Remote

♦Operates five devices (TV, VCR, Cable, Satellite, A/V Receiver)  
♦Lighted component keys which indicate what device is currently being used ♦Preprogrammed, 621 codes that work over 6,400 models ♦New ergonomic design features a contoured case, index finger grooves, and keys grouped in clusters for easy operation ♦Satellite cursor control is tailored for use with a Home Theatre system, keypad design allows movement through menus with ease ♦Retains codes when replacing batteries ♦New flat back design for easy operation ♦Money back guarantee ensures customer satisfaction ♦Toll free customer service number provides the customer with friendly, knowledgeable assistance ♦Requires 2 AAA batteries (#140-150 not included)



#180-806 ..... \$29.95 (1-3) \$26.95 (4-UP)

## 3M 3/4" Temflex™ 1700 Vinyl Electrical Tape

General purpose 7 mil electrical tape. UL listed and CSA approved. 3/4" x 60' rolls.



#350-052 ..... 75¢ (1-9) 59¢ (10-UP)

## Gold Plated A/V Cables

A super quality, "siamese" type cable. Two RCA cables for stereo (audio) signal from VCR to receiver/stereo TV and one low noise coaxial type cable for video.



Part #	Length	Price (1-9)	Price (10-UP)
180-120	3 ft.	\$4.25	\$3.95
180-118	6 ft.	4.90	4.50
180-121	12 ft.	8.95	7.95
180-124	20 ft.	12.75	11.50

*If you haven't received a copy of our current 260 page catalog ... have one added to your order or give us a call and we will send one out to you immediately.*

## 6-1/2" Round Coaxial System

Designed for the home and office, these 6-1/2" round in-walls are ideal for ceiling installations, or for use as rear channel surround speakers. Adding music to the kitchen, den, bath, or patio has never been easier! System features a weather resistant 6-1/2" treated paper cone with poly foam surround, coaxially mounted 1/2" polymer dome tweeter, and built-in crossover with a mylar capacitor in the tweeter feed. Retrofit design allows installation in both new and existing construction in just minutes. System includes removable steel mesh grills, built-in mounting bracket, hardware, and installation instructions.

**Specifications:** ♦Impedance: 8 ohms ♦Frequency response: 60-20,000 Hz ♦Power handling capability: 30 watts RMS/45 watts max. ♦Sensitivity: 89 dB 1W/1m ♦Dimensions: 9" round x 2-7/8" deep. ♦Net weight: 5 lbs. per pair.

#300-408 ..... \$69.95 (1-3 PRS) \$62.75 (4PR-UP)

## 3 Amp Power Supply

This fully regulated power supply is perfect for powering CBs, car radios, and other 12 VDC devices that draw up to 3 amps. Heavy duty steel housing with front mounted switch and binding posts. Short circuit and overload protection!



**Specifications:** ♦Output Voltage: 13.8 VDC (fixed) ♦Output Current: 3A (cont), 5 amps (surge) ♦Ripple Voltage: Less than 3mV at rated output ♦Input Voltage: 120 VAC, 60Hz ♦Dimensions: 5-1/2" x 3-1/2" x 6-1/2" ♦Weight: 5 lbs.

#120-530 ..... \$19.95 (1-3) \$18.50 (4-UP)

## DMM and LCR Meter

In addition to functions found in regular DMM's, this meter can also measure inductance in 5 ranges (4mH, 40mH, 400mH, 4H, 40H), capacitance in 5 ranges (4nF, 40nF, 400nF, 4uF, 400uF), frequency in 4 ranges (4KHz, 40KHz, 400KHz, 4MHz), TTL logic test, diode test and transistor hFE test. 5 AC/DC ranges up to 1000V (AC750V), 3 AC/DC current ranges up to 20A and 7 resistance ranges up to 4000 M ohms. Includes test leads, battery, spare fuse, and manual. Net weight: 1 lb.



#390-513 ..... \$85.90 EACH

## 2.5W Mini Audio Amplifier

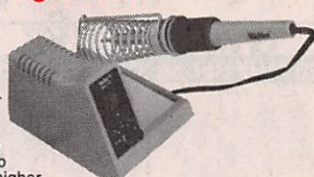
This amp contains both pre-amplifier and power amplifier on a super small board measuring only 1-5/8"x1-1/4". Maximum output power is 2.5W into 4 ohms with 12VDC input power. No adjustments required. Short circuit protected.



#320-215 ..... \$9.95 EACH

## Weller WLC100 Soldering Station

The Weller WLC100 solder station is ideal for the professional, serious hobbyist, or kit builder who demands higher performance than usual of a standard iron, but without the high cost of an industrial unit. Power is adjustable from 5 to 40 watts. Includes 40 watt pencil iron. UL approved. Net weight: 1-3/4 lbs. Replacement sponge #372-119.



#372-120 ..... \$39.95 EACH

## "44" Solder

Kester "44" rosin core solder is designed for electronic and electrical work. It uses a fast acting, instant wetting, non-corrosive, and non-conductive flux for faster soldering and a strong, long lasting bond.



Part #	Alloy	Lead/Tin	Spool	Dia.	Price (1-3)	Price (4-UP)
370-080	60/40	1 lb.	.031"		\$8.50	\$7.95
370-090	60/40	1 lb.	.050"		8.50	7.95
370-098	60/40	4 lb.	.031"		33.90	31.80
370-088	60/40	1/2 lb.	.020"		6.95	5.75
370-072	63/37	1 lb.	.020"		14.90	13.50
370-086	63/37	1/2 lb.	.031"		9.95	8.50
370-074	63/37	1 lb.	.031"		12.50	11.50
370-087	36/37	1/2 lb.	.031"		7.95	6.75

## Pro Wick

Pro Wick's advanced fine braid design provides wicking action that is second to none.



Part #	TS #	Size	Length	Price (1-9)	Price (10-UP)
341-415	1802-5	.06"	5'	\$1.40	\$1.25
341-416	1803-5	.08"	5'	1.45	1.30
341-417	1804-5	.10"	5'	1.60	1.45
341-424	1802-10	.06"	10'	2.75	2.50
341-425	1803-10	.08"	10'	2.80	2.55
341-426	1804-10	.10"	10'	2.95	2.70
341-440	1802-25F	.06"	25'	6.80	6.30
341-441	1803-25F	.08"	25'	6.85	6.35
341-442	1804-25F	.10"	25'	7.60	7.00
341-418	1802-100	.06"	100'	21.90	20.50
341-419	1803-100	.08"	100'	21.90	20.50
341-423	1804-100	.10"	100'	23.90	22.50

725 Pleasant Valley Dr., Springboro, OH 45066-1158  
Phone: 513-743-3000 ♦ Fax: 513-743-1677  
E-mail: sales@parts-express.com

KEY CODE: ENMI

**LARGEST SELECTION OF SPEAKER DRIVERS IN THE COUNTRY!**

VISIT OUR WEB SITE AT

**www.parts-express.com**

OR CALL TOLL FREE

**1-800-338-0531**



# ALFA ELECTRONICS

## HIGH QUALITY TEST EQUIPMENT

Visit [www.alfaelectronics.com](http://www.alfaelectronics.com) for complete info

Call 1-800-526-2532 for Order and Free Catalog

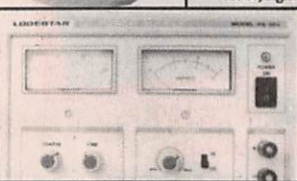


**DMM**  
**DMM-89S** (\$179.00): true rms, AC/DC (V,A),  $\Omega$ , bar graph, freq, capac., dBm, logic, diode  
**DMM-23T** (\$99.95): 4 1/2 digit, true rms, high resol. (10 $\mu$ V, 10nA, 10m $\Omega$ ), hFE, diode, contin.  
**DMM-20** (\$74.95): AC/DC (V,A), Freq, cont., Capac, Induct.,  $\Omega$ , hFE, diode, duty cycle  
**DMM-122** (\$59.95): DC/AC(V,A),  $\Omega$ , hFE, diode, capacitance, freq, logic, continuity  
**DMM-123** (\$44.95): DMM + capacitance, DC/AC(V,A),  $\Omega$ , hFE, diode, continuity  
**DMM-10** (\$19.95): 3 1/2 digit, DC/AC V,  $\Omega$ , hFE, diode, signal output(+3V, -0.5Vsq., 50% duty)



**LCR/COUNTER**  
**CAP-15** (\$49.95): 3 1/2 digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment.  
**LCR-24** (\$119.95): 0.1 $\mu$ H-200H, 0.1pF-2000 $\mu$ F, 0.01 $\Omega$ -20M $\Omega$ , diode test. *New Model*  
**LCR-131D** (\$219.95): autorange, 0.1 $\mu$ H-10kH, 0.1pF-10mF, 1m $\Omega$ -10M $\Omega$ , Q Factor, serial/parallel, 120Hz/1kHz testing mode.  
**FC-1200** (\$129.95): 1.25GHz Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 30mV (440MHz)

**FLUKE SPECIALTY**  
**12B** \$ 94.95 • AC Current Probe \$34.95  
**70-III** \$ 99.00 • DC/AC Current Probe \$79.95  
**73-III** \$125.00 • Mini AC Clamp \$59.95  
**75-III** \$155.00 • AC Clamp w/temp \$89.95  
**77-III** \$173.00 • DC/AC Clamp \$109.95  
**79-III** \$195.00 • Thermometer \$69.95-\$89.95  
**87-III** \$325.00 • IR Thermometer \$189.95  
**92B-III** \$1,445 • Sound Level Meter \$169.95  
**96B-II** \$1,695 • Tachometer \$169.95-\$219.95  
**99B-III** \$2,095 • EMF Tester \$69.95  
**105B** \$2,495 • Pressure Meter \$299.95  
**123-III** \$1,130 • Watt Meter \$129.95  
**863E** \$555 • High Voltage Probe \$59.95  
**867B** \$740 • pH Meter \$79.95  
 • Light Meter \$79.95-\$89.95



**Single Output DC Power Supplies**  
 • Constant current, constant voltage mode  
 • Short Circuit and overload protected  
**Analog Meters Display**  
**PS-303** (\$159.00) 30V/3A  
**PS-305** (\$219.95) 30V/5A  
**PS-8112** (\$399.95) 60V/5A  
**PS-1610** (\$289.00) 16V/10A  
**PS-8107** (\$399.95) 30V/10A  
**Digital Volt, Analog Current**  
**PS-8200** (\$179.95) 30V/3A  
**PS-8201** (\$239.95) 30V/5A  
**Digital Volt & Current Display**  
**PS-8300** (\$199.95) 30V/3A  
**PS-8301** (\$259.95) 30V/5A

**Triple Output**  
 • Independence or Tracking operation  
 • Parallel to double current output (PS-8102 & PS-8103 only)  
**Triple Output (Analog displays)**  
**PS-8102** (\$399.95) 30V/3A/30V/3A  
**PS-8103** (\$489.95) 30V/5A/30V/5A  
**Digital Displays**  
**PS-8202** (\$499.95) 30V/3A/30V/3A  
**PS-8203** (\$549.95) 30V/5A/30V/5A

**AUDIO/RF/FUNCT. GEN.**  
**RF Generator • SG-4160** (\$124.95) 100kHz-150MHz sine waves in 8 ranges  
**• SG-4162AD** (\$229.95) with 6 digit counter  
**Audio Generator • AG-2601** (\$124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave  
**• AG-2603AD** (\$229.95) with 6 digit counter  
**Function Generator • FG-2100A** (\$154.95) 0.2Hz-2MHz, 5mV-20V $\mu$   
**• FG-2103** (\$329.95) Sweep 0.5Hz-5MHz

## GW/INSTEK

20 MHz Scope	Cursor Readout	Triple Output	Single Output	Programmable	FUNCTION GENERATOR	BENCHTOP DMM
<b>OS-620</b> \$324.95 • Most economical scope • Dual CH/X-Y operation • 1 mV/div sensitivity • Z-axis input, CH1 output • TV syn, ALT trigger • 2 probes (x1, x10)	<b>OS-626G</b> \$599.95 • Readout & Cursor meas • Dual CH / Delay sweep • Built-in delay line • ALT trigger, Hold-Off • Z-axis input, CH1 output • 2 probes (x1, x10)	• 2 variable out 0-30V, 0-3A • One fixed 5V, 3A output • Auto track, serial, parallel • Const. volt, current mode • 4 analog or 2 digital display <b>PC-3030</b> (\$499.95) <b>PC-3030D</b> (\$549.95) digital	• Const voltage, current mode • Voltage regulation $\leq 0.01\%$ • Current regulation $\leq 0.2\%$ <b>PS-1830</b> (\$198.95) 18V/3A <b>PS-1850</b> (\$214.95) 18V/5A <b>PS-1830D</b> (\$214.95) 18V/3A <b>PS-1850D</b> (\$244.95) 18V/5A	• Auto serial/parall. (PPT ser) • Auto track (PPT series), IEEE-488.2 and SCPI compatible command set <b>PPS-1860G</b> (\$1,149.95) 18V/6A <b>PPS-3635G</b> (\$1,149.95) 36V/5.5A <b>PPT-1830G</b> (\$1,499.95) 18V/3A <b>PPT-3615G</b> (\$1,499.95) 36V/1.5A	<b>FG-8020G</b> (\$209.95) • 0.02Hz-2MHz w/counter • Sine/Sqr/Tri/pulse/Ramp <b>FG-8020G</b> (\$209.95) • 0.02Hz-2MHz w/counter <b>FG-8050</b> (\$449.95) Sweep • 0.05Hz-5MHz w/counter • INT/EXT AM/FM mod	<b>DM-8034</b> (\$179.95) 3 1/2 dgt • AC/DC (V,A), $\Omega$ , diode <b>DM-8040</b> (\$339.95) 3 1/2 dgt • ACV to 50kHz, true rms <b>DM-8055G</b> (\$889.95) 5 1/2 dgt • 0.006% accuracy, GPIB • dBm, auto, REL, min/max

**ALFA ELECTRONICS**  
 P.O. BOX 8089  
 PRINCETON, NJ 08543-8089

TEL: (800)526-2532 / (609) 897-1135  
 FAX: 609-897-0206  
 E-mail: [sales@alfaelectronics.com](mailto:sales@alfaelectronics.com)

Call / Write / Fax / Email for FREE CATALOG  
 Visa, MC, AMEX, COD, PO Accepted. OEM Welcome.  
 1 Year Warranty (2 Years for GW/Instek)

CIRCLE 213 ON FREE INFORMATION CARD

# ❖ ATTENTION CABLE VIEWERS ❖

## CABLE VIEWERS... get back to your BASIC Cable Needs

### Call 800-577-8775

For information regarding all of your BASIC cable needs.



5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ ANY SIZE ORDER FILLED WITH SAME DAY SHIPPING

We handle NEW equipment ONLY - Don't trust last year's OBSOLETE and UNSOLD stock!  
 COMPETITIVE PRICING—DEALERS WELCOME

HOURS: Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.  
 \*Refer to sales personnel for specifications.

**BASIC**  
**ELECTRICAL**  
**SUPPLY &**  
**WAREHOUSING**  
**CORPORATION**

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

CIRCLE 314 ON FREE INFORMATION CARD



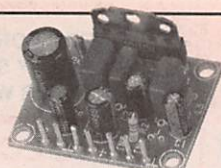
27pc•kit

**\$12.95**

K2637

### MINIATURE AUDIO AMPLIFIER KIT

Big sound from a small unit!  
Small PCB with both pre- and power amp  
Short circuit protected  
Input sensitivity : 20mV  
Max. output power : 2.5W  
Power supply : 4.5 to 15VDC



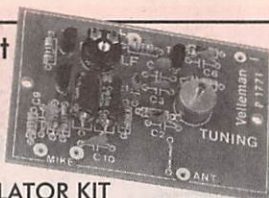
28pc•kit

**\$12.95**

K1771

### FM OSCILLATOR KIT

Use for home broadcasts, baby monitoring, security  
Frequency range : 100-108MHz  
Microphone input  
No coils to wind  
Power supply : 9-12VDC



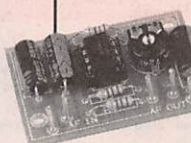
17pc•kit

**\$9.95**

K1803

### UNIVERSAL MONO PRE-AMPLIFIER KIT

Boost any audio signal up to 40dB (x100)  
Max input signal : 40mV  
Frequency range : 20Hz to 20KHz  
Power supply : 10-30VDC/10mA



19pc•kit

**\$19.95**

K5300

### STROBOSCOPE KIT

Stage effects at home  
Adjustable flash rate: 2-20 flashes/second  
Powerful flash tube  
Supply voltage : 110-125V AC



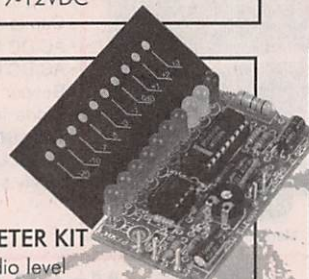
36pc•kit

**\$18.95**

K4304

### 10 LED VU METER KIT

Visualise any audio level  
Line or speaker inputs  
DOT or BAR mode. Range : -20 to +3dB  
Front-panel included. Vertical or horizontal mounting. Power supply: 10-15VDC



27pc•kit

**\$24.95**

K5002

### HALOGEN LAMP DIMMER KIT

Light control at the touch of a button  
Suitable for loads up to 3A  
Can control small motors with brushes  
Push button operation  
Add any number of buttons  
Power supply : 110-125V AC



16pc•kit

**\$14.95**

K6708

### IR REMOTE CONTROL KEY CHAIN TRANSMITTER

For K6709 Kit  
Range : Up to 24 feet  
LED operation indicator  
8748 different code settings  
Power supply : 12V battery



66pc•kit

**\$24.95**

K6709

### IR REMOTE RECEIVER

For K6708 Kit  
The easy way to add a remote control  
10A relay with mom. or pulse changeover contact  
Allows control of alarm systems, garage doors, outdoor lighting, garden pumps, etc  
LED reception indicator  
Accepts multiple transmitters K6708  
Power supply 2x9VAC or 12 to 16VDC



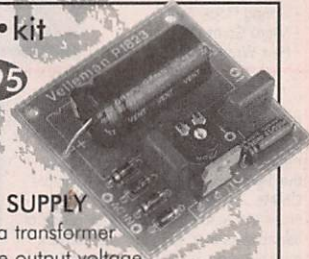
12pc•kit

**\$12.95**

K1823

### 1 AMP POWER SUPPLY

Just add a transformer  
Adjustable output voltage  
1.5V to 35V/1A max.  
Short circuit and thermal protection  
Max input voltage : 37VDC  
Max dissipation : 15W



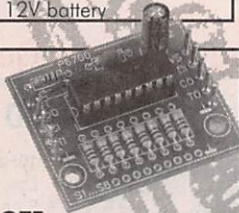
18pc•kit

**\$14.95**

K6700

### 2-WIRE REMOTE CONTROL TRANSMITTER

Transmitter For K6701 Kit  
Control up to 16 devices\*, with only 2 wires! Remotely control 8 (\*16 with 2 units) devices up to 160 feet away. Transmitter is powered over the data wires. Simple operation by means of switches (not included)  
Transmitter can drive multiple receivers



46pc•kit

**\$24.95**

K6701

### 2-WIRE REMOTE CONTROL RECEIVER

For K6700 Kit  
8 open collector outputs (max 200mA)  
LED output status indication  
Daisy chain 2 units for 16 outputs  
Power supply : 6-16V DC

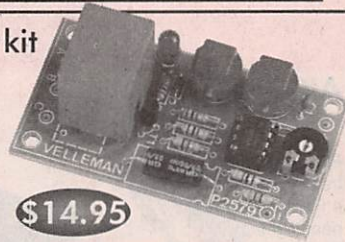
18pc•kit

**\$14.95**

K2579

### UNIVERSAL START STOP TIMER KIT

0-15 Minutes Adjustable Delay  
3A changeover relay contact  
Start and Stop button included  
LED function indicator  
Can be modified for longer delays  
Power supply : 12V/55mA



# velleman

7415 Whitehall Street Suite 119

Fort Worth, TX 76118

(817) 284-7785 F.: (817) 284-7712

www.velleman.be email : velleman@earthlink.net

Questions ? Contact us for a list of US distributors or to get your **FREE** catalogue

CIRCLE 282 ON FREE INFORMATION CARD



**CALL TOLL FREE**  
(800) 292-7711 orders only  
Se Habla Español

# C&S SALES

EXCELLENCE IN SERVICE

LOOK FOR OTHER  
MONTHLY SPECIALS  
ON OUR WEBSITE

## XK-700 Digital / Analog Trainer

Elenco's newest advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square waveforms and a 1560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

**XK-700**  
Assembled and Tested  
**\$189.95**

**XK-700 - SEMI KIT**  
w/ Fully Assembled PC Board  
**\$174.95**

**XK-700K - Kit**  
**\$159.95**



Made in the USA

## Digital Multimeter Model M-1740

**\$39.95**  
Free Holster

- 11 functions
- Freq to 20MHz
- Cap to 20µF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-1244 safety specs



## DIGITAL LCR METER Model LCR-1810

**\$99.95**



- Capacitance .1pF to 20MF
- Inductance 1µH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

## 15pc. VCR Service Tool Kit Model TK-1400

- Inclined Base Screwdriver
- Eccentric Screwdriver
- 2mm & 3mm Fine Adjust Screwdriver
- VHS VCR Head Puller
- Retaining Ring Remover
- 3 Reversible Screwdrivers
- Spring Hook Tool
- Micro Screwdriver
- Hex Wrench Set

**Special**  
**\$24.95**



## Model M-6100

The M-6100 is Elenco's most sophisticated meter with almost every possible feature available. The M-6100 even has a computer interface for viewing and storing data on a personal computer. It comes complete with software, RS-232 cable, test leads and manual.

**\$99.95**

## Model XP-581

4 Fully Regulated DC Power Supplies in One Unit  
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A  
1 Variable - 2.5 - 20V @ 2A

**\$79.95**



## Tektronix DMMs

For high performance digital multimeters that are accurate, reliable, and rugged, the DMM900 series extends the Tektronix line of already affordable DMMs. Twice the accuracy. Up to 10 times the resolution. And a full range of capabilities that span voltage, current, dual numeric display, 3 year warranty, and autoranging capability. All backed by the reliability of the Tektronix brand.



912 \$179  
914 \$229  
916 \$275

## Power Supply Kit Model XP-720K

3 fully reg. DC supplies  
1.5VDC - 15VDC @ 1A  
-1.5VDC to -15VDC  
5VDC @ 3A  
Plus  
6.3VAC @ 1A and  
12.6VAC C.T. @ 1A

**\$54.95**



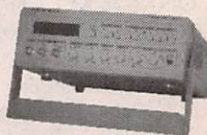
Available assembled Model XP-720 \$84.95

## Sweep Function Generator with built-in Frequency counter

Model GF-8036

**\$225**

- Range .02Hz - 2MHz
- Sine, Square, Triangle, Pulse, Ramp
- Ext. counter 1Hz - 10MHz



## Kit Corner

over 100 kits available

### AK-700

**\$15.95**

Phone kit with training course  
4 Flashing neon lights  
See thru case



### RADIO CONTROL CAR KIT MODEL AK-870

- 7 functions
- Remote control included

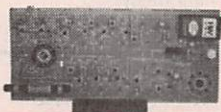
**\$24.95**

No Soldering Required



### Model AM/FM-108K Transistor Radio Kit with training course

**\$29.95**



Free Stand

### 35mm Camera Kit Learn all about photography AK-540

**\$14.95**



No Soldering Required

### Digital Capacitance Meter Model CM-1555

**\$44.95**



- Capacitors from .1pF to 20µF
- 3 1/2 Digit LCD
- Zero adjust
- special insertion jack
- 1/2% basic accuracy
- Tilt stand

### Digital Audio Generator with built-in Counter

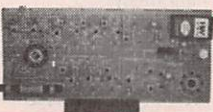
SG-9300

- 10Hz - 1MHz
- Low Distortion
- Sine/Square waves
- Built-in 150MHz Frequency Counter

**\$175**



SG-9200 Analog/No counter \$119.95



### RF Generator with Counter

Model SG-9500

**\$225**

- 100KHz - 150MHz
- Internal AM Mod of 1KHz
- RF Output 100mV - 35 MHz
- Audio Output 1KHz @ 1V rms

SG-9000 Analog/No counter \$119.95

**WE WILL NOT BE UNDERSOLD C&S SALES, INC.**

150 W. CARPENTER AVENUE  
WHEELING, IL 60090  
FAX: (847) 541-9904 (847) 541-0710  
[http://www.elenco.com/cs\\_sales/](http://www.elenco.com/cs_sales/)



**15 DAY MONEY BACK  
GUARANTEE  
FULL FACTORY WARRANTY**  
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 322 ON FREE INFORMATION CARD



**Same Day  
Shipping**

**C & S SALES**  
Your one stop source for  
all your electronic needs!

CALL OR WRITE FOR OUR  
**NEW FREE 64 PAGE  
CATALOG!**  
(800) 445-3201

## Fluke Scopemeters



123 ..... NEW ..... \$1140  
92B ..... \$1445  
96B ..... \$1695  
97 ..... \$1695  
99B ..... NEW ..... \$2095  
105B ..... \$2495

**ALL FLUKE  
PRODUCTS  
ON SALE**

## B & K PRECISION SCOPES

20MHz DUAL-TRACE  
Model 2120B - 2 Year Warranty  
**Special \$375**

Model 2125A with delayed sweep  
**\$539.95**



- 1mV/division sensitivity
- AUTONORM triggered sweep operation
- AC, TVH, TVV and line coupling
- Calibrated 19 step time-base with x10 magnifier
- Compact low-profile design

## Affordable Spectrum Analyzers by B&K



- 500MHz Series** BK2615A \*1250  
BK2620A \*1675
- 150KHz to 500MHz
  - Dynamic Range 80dB(113dB with attenuation)
  - +20dB maximum input
  - 12.5 and 400KHz resolution bandwidth
  - 150KHz/hour stability
  - Built-in tracking generator(Model 2620A)
- 1.05GHz Series** BK2625A \*1925  
BK2630A \*2595
- 150KHz to 1050MHz
  - Dynamic Range 80dB(113dB with attenuation)
  - AM & FM demod included
  - 20 and 400KHz resolution bandwidth
  - 150KHz/hour stability
  - Built-in tracking generator(Model 2630A)

## PORTABLE SEMICONDUCTOR TESTER



**B&K 510**  
**\$199.00**

- In or out-of-order circuit tests for transistor, FETs, SCRs and darlington.

## 20MHz Sweep / Function Generator with Freq Counter

- B&K 4040**
- 0.2Hz to 20MHz
  - AM & FM modulation
  - Burst Operation
  - External Frequency counter to 30MHz
  - Linear and Log sweep



**\$399**

10MHz B&K 4017 \$309  
5MHz B&K 4011 \$239

## Quality Scopes by Elenco

**Lowest Prices of the Year!**



**60MHz**  
**DS-603 \$995**

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

**S-1360 \$749**

- Analog with Delayed Sweep
- Component Tester

**100MHz**

**S-1390 \$895**

- Analog w/ delayed sweep
- Dual Time Base
- TV Sync

**Includes  
Free Dust  
Cover and  
Probes**



**40MHz**

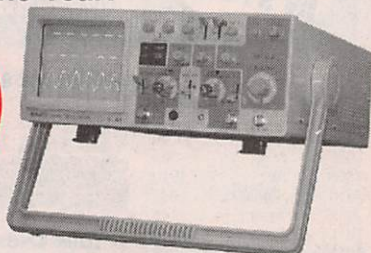
**S-1345 \$569**

- Analog with Delayed Sweep
- Component Tester

**S-1340 \$475**

- Analog / TV Sync
- 1mV Sensitivity

**2 Year  
Warranty**



**25/30MHz**  
**DS-303 30MHz \$895**

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

**DS-203 20MHz \$695**

- Analog / Digital Storage

**S-1330 \$439**

- 25MHz Analog
- Delayed Sweep

**S-1325 \$325**

- 25MHz Analog
- TV Sync
- 1mV Sensitivity

## Fluke Multimeter Specials



**F-73III**  
**\$119**

List  
\$135



**F-T1III**  
**\$165**

List  
\$185



**F-79II**  
**\$175**

List  
\$199



**F-87**  
**\$289**

List  
\$335

## B&K Precision Multimeter Specials



- Accurately measures capacitance, resistance and inductance.
- Measures dissipation factor of capacitors and Q of inductors.
- Simultaneously displays measured value and Q or dissipation factor.
- Displays the difference between measures and reference values.

**Model 878**

**\$219.95**



- 50,000 count
- 0.025% DCV
- 0.07% ohms
- Min/Max/Avg
- True RMS, AC, or AC+DC
- 100KHz AC response
- Capacitance to 50,000pF
- Frequency, duty cycle, pulse width
- dB across 1Ω to 10kΩ

**Model 5390**  
**\$295.00**

## MX-9300

## Four Functions in One Instrument

### Features:

- One instrument with four test and measuring systems:
  - 1.3GHz Frequency Counter
  - 2MHz Sweep Function Generator
  - Digital Multimeter
  - Digital Triple Power Supply
- 0-30V @ 3A, 15V @ 1A, 5V @ 2A



**\$459.95**

## GUARANTEED LOWEST PRICES

## C&S SALES, INC.

150 W. CARPENTER AVENUE  
WHEELING, IL 60090  
FAX: (847) 541-9904 (847) 541-0710  
[http://www.elenco.com/cs\\_sales/](http://www.elenco.com/cs_sales/)

UPS SHIPPING: 48 STATES 5%  
OTHERS CALL FOR DETAILS  
IL Residents add 8.25% Sales Tax



**15 DAY MONEY BACK  
GUARANTEE**

**FULL FACTORY WARRANTY**

PRICES SUBJECT TO CHANGE WITHOUT NOTICE  
Most Major Credit Cards Accepted



**OVER  
30,000  
ITEMS  
IN STOCK**

**LARGE VARIETY  
SAME DAY SHIPPING**

**Minimum Orders \$20.00**

Not Including Shipping & Handling

**Dalbani®**

*The Ultimate Saving Source*

**SEMICONDUCTORS**

Original #	Brand	Replaces
7805	Tesla	960
7806	Ank	962
7809	Ank	1910
7810	Samsung	1968
7812	Tesla	966
7815	Tesla	968
7818	Tesla	958
7824	Tesla	972
7905	Tesla	961
7906	Tesla	963
7908	Tesla	965
7912	Ank	967
7918	Tesla	959
7924	Tesla	971

**YOUR CHOICE**

**45¢**

each

**POPULAR FUSE KIT 180 Piece Kit**

Kit Contains 10 Pieces of each of these items:

- AGC Type : 0.5A, 1A, 1.5A, 2A, 2.5A, 3A, 4A, 5A, 6A, 10A, 15A
- Ceramic Type : 15A
- GMA Type : 1A, 1.5A, 2A, 3A, 4A, 5A

Everything Comes in a Durable Plastic Box

**Item # 10-2050**

**\$13.95**

**TUN-O-WASH® (CFC Free)**

Fast drying electronics grade cleaner for tuners, controls and PC boards.  
• CFC and HCFC free  
• Not for use on energized equipment  
• Due to the chemical content, this product can be only shipped by UPS ground service.

**Item # 30-0100**

(12.5 Oz aerosol)

**\$11.75**

**DALCO DIGITAL MULTIMETER**

- DC Voltage: 200m-1K
- AC Voltage: 200-750V
- DC Current: 20m-20
- Transistor and Diode Test
- Continuity Buzzer
- Polarity indicator appears on LCD
- Test Probes Included
- Dimensions: 4.96" x 2.76" x 9.4"
- Weight: 6 oz.
- 9V Battery Included

**Item # 50-2895**

**\$9.95**

**Dalco®**

**ECONOMICAL  
SOLDER WICK**

- Length: 5 feet
- Width: 0.15"
- Safer Desoldering
- Fast Response

**Item # 51-1050**

5 Feet

*Removes solder easy*

**\$1.10**

**SOLDER ROLL**

- 1 LB Spool
- 370° F melting point
- Fastest solder
- Alloy 60/40, tin lead, non corrosive flux, Diam. 1.0mm

**Item # 51-1005**

**\$5.49**

**DUAL  
HELPING  
HANDS**

- Hold Work in any Position to leave hands free for soldering

**Item # 50-1325**

**\$3.45**

**SOLDERING IRON**

- General Purpose Applications
- 117V AC, 30 Watts

**Item # 51-1335**

**\$3.25**

**WELLER WLC100  
SOLDERING STATION**

**Weller**

- Ideal for the professional, serious hobbyist
- Variable power control (5-40W)
- 40W pencil iron and ST inter changeable tip
- Replaceable heating element
- Cushioned foam grip • Safety guard iron holder
- On/off switch with "power-on" indicator light

**Item # 51-1505**

**\$38.90**

**SHIP UP TO 5lbs FOR ONLY**

**\$3.95**

**UPS  
2ND DAY AIR**

Plus handling & C.O.D. charge if it applies

**THE MOST POPULAR  
VCR ALIGNMENT TOOL KIT**

**\$24.99**

- VCR Head pull
- Retaining ringremover
- Micro screwdriver
- Fitted vinyl Case
- 7 Assorted head & guide aligner
- Dimensions: 9 1/2" (W) X 12 1/4" (L)
- 3 Reverseable screwdrivers (Small-Flat-Phillips)
- Spring hook
- Hex key set
- Soft zippered case

**Item # 50-888**

**HEAVY DUTY COLOR  
CODED LEADS**

- 10 Leads
- 11" Long Wire Lead
- Insulated 11/2" Alligator Clips
- 20 Gauge Wire Size
- Black, Green, Red, Yellow, White

**Item # 56-500**

**\$2.95**

**Dalco® SWING ARM  
MAGNIFYING LAMP**

**\$36.72**

- Spring-Balanced 45" extension arm with 3 conductor cord 120V 60Hz
- Steel Shade supplied with a precise 3 diopterlens and a 22W fluorescent circline tube
- Comes with a lamp

**Item # 54-0120**

*White Color*



**Dalbani®**

4225 NW 72ND AVE. MIAMI, FLORIDA 33166

TEL : (305) 716-1016 ----- FAX : (305) 594-6588

**Free 400 Page Color Catalog  
With your First Order**

**1-800-325-2264**



# ONLY COOL-AMP SILVERPLATES ON THE JOB.

From a customer testimonial:

"Ok, your edge connectors don't connect. Or you want to plate your own PC creations, but you don't want to bother with electro-plate solutions. The plating on the socket...has worn off and no longer makes reliable contact...what are you going to do now?"

"Give the people at Cool-Amp a call. They have a silver plating compound I have used for the past couple of years that solves all of the above problems and more. This white powder has an infinite shelf life...and is easy to use."

"It will actually put a permanent silver plate on copper, brass or bronze...There are no messy or dangerous chemicals. Application could not be easier. Use a clean rag and a little bit of water and just rub it on a clean surface. In minutes you can permanently silver plate a circuit board or replating a power amp tube or socket."

"It has saved me time, money and my sanity."

Cool amp has even outperformed electroplating in recent tests. It is time-proven since 1944.

**COOL-AMP**

## AND CONDUCTO-LUBE. THE SILVER-BASED CONDUCTIVE LUBRICANT.

The upstart, since 1952. Developed for switches, uses continue to expand to all applications needing a conductive lubricant.

**Conducto-Lube**

**ORDER FACTORY DIRECT:**  
**503-624-6426 or FAX 503-624-6436**

<http://www.thomasregister.com/cool-amp>

CIRCLE 228 ON FREE INFORMATION CARD

## Credit Card FINANCING

2 payments of \$29 Books

2 payments of \$29 Books

back issue, perfect for Service & Experimenter

IC MASTER

97 ICM CD

2 Easy Payments of \$75!!

2 Easy Payments Any Product

Complete Catalogs of ALL Major Component Manufacturers

2 payments of \$29 97 EEM CD or books

2 payments of \$44 98 EEM CD

2 payments of \$52 96 ICM Books for Lite Design & Service

2 payments of \$75 97 ICM CD 97 for Moderate design

2 payments of \$65 97 ICM Bks

2 payments of \$99 98 ICM CD for Advanced Design

Service Center Favorite

SEMICONDUCTOR CROSS REFERENCE & SPEC

Quarter Million Transistors, ICs & Diodes with REFERENCE

A Specialist in "Hard to Cross House Numbers"

Easy, Powerful & Fast. The Most Comprehensive Software Sold. A selection yields Device Specifications & 75 to 250 Potential Replacements!

Replacement Numbers are Totally Global including Domestic, Asian, European, House Branded, as well as ECG, NTE, SK & GE. Displays Case Drawings, Lead Configuration & Pin-outs for many Devices. Coverage of Replacement Numbers is Very Impressive. 7 Disk Set (17 Meg decompressed) For DOS, Win3.1 & 95 Latest Version 7.11 Includes Many Helpful Conversion Utilities, Tables & Formulas.

Includes: 4 HUGE Consumer Electronics Industry Directories

1- Consumer Electronics Parts Sources (Service) 2- Consumer Electronics Manufacturers 3- The Entire Computer Industry 4- Semiconductor Manufacturers

Perfect for Service, Engineering and Purchasing.

Shop the way the Pro's do, Use Their Tools!

These are the books that find the "Gold". For many years they've been used by the Sharpest Purchasing Agents. Look under every rock... they're impossible to find at ANY price, let alone a great deal like this. Find: Distributors, Manufacturers and Service providers for Products, Services or ANY Component Parts imaginable. Sources for Everything from Gears to Semiconductors to Foreign Assembly Services.

1 Single Payment \$25 \$235 publisher

all 6 pieces!

WOW 2 payments of \$282! Credit card Plan

Great Deals

2 payments of \$282 Compaq 486 DX4-100 16m - 710m - 10.4"ds - W95-PCMCIA

Only a few left

Real Beauties!

2 payments of \$379 Compaq Pentium 90 16m - 810m - 9.4"Active - PCMCIA may differ slightly from illustration

Parts Source Library Best Kept Secrets

All Cards & COD Int'l Orders email: netcomd@aol.com 10-9 EST

Netcom 800-733-3733 ext 6300 FAX 516-826-7776 7 Days



# PIC'n Books

## LEARN ABOUT PIC MICROCONTROLLERS

### EASY PIC'n - Beginner

\$29.95

- Programming techniques  
Instruction set, addressing modes, bit manipulation, subroutines, loops, lookup tables, interrupts
- Using a text editor, using an assembler, using MPLAB
- Timing and counting (timer 0), interfacing, I/O conversion

### PIC'n Up The Pace - Intermediate

\$34.95

- Serial communication - PIC to peripheral chips and PIC-to-PIC
- Serial EEPROMS
- LCD interface and scanning keypads
- D/A and A/D conversion - several methods
- Math routines

### PIC'n Techniques - Intermediate

\$34.95

- 8-pin PICs
- Timer 1, timer 2 and the capture/compare/PWM (CCP) module
- Talking to a PIC with a PC using a terminal program
- Test equipment and data logger experiments

See Table Of Contents: <http://www.sq-1.com>

+ \$4 s/h in US for 1 book, \$5 for 2 books, \$6 for 3 books

VISA, MC, AMEX, MO, Check

CA residents please add 7.25% CA sales tax

PIC and MPLAB are trademarks of Microchip Technology Inc.

**SQUARE 1 ELECTRONICS**

P.O. Box 501, Kelseyville, CA 95451

Voice (707) 279-8881 FAX (707) 279-8883

Web Site: <http://www.sq-1.com>

E-Mail [sqone@pacific.net](mailto:sqone@pacific.net)

# World Passing You By?

Are you interested in Microprocessors & Embedded

Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers.

So don't be left behind; this is information you need to know!

## Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

**EMAC, inc.**

11 EMAC WAY, CARBONDALE, IL 62901  
618-529-4525 Fax 457-0110 BBS 529-5708

World Wide Web: <http://www.emacinc.com>

1985 - 1998

OVER

12

YEARS

OF SERVICE

## VIDEO SYNC GENERATOR



Restores Horizontal and Vertical Sync Lines from Distorted Video



For Free Information Package and Pricing

VISA Call (219) 233-3053

[www.south-bend.net/rcd](http://www.south-bend.net/rcd)

R.C. Distributing, P.O. Box 552, South Bend, IN 46624

## CABLE TV DESCRAMBLERS

\*GUARANTEED LOWEST PRICES\*  
\*DESCRAMBLERS FOR ALL SYSTEMS\*

\*FREE SHIPPING\*  
CRAZY LIZ'S ELECTRONIC WAREHOUSE

CALL TODAY!

1-800-391-7803

EQUIPMENT IS NEW & GUARANTEED

**MECI**  
Your Electronics Value Company

340 East First Street  
Dayton, Ohio 45402

## Tons of Electronics

Get your FREE catalog today and discover some of the best deals in electronics. We have thousands of items ranging from unique hard-to-find parts to standard production components. Call, write or fax today to start your subscription to one of the most unique catalogs in the industry, filled with super values on surplus electronic and hobbyist type items.



Check out our 10,000 item on-line catalog <http://www.meci.com>

Order Toll Free Why pay more?  
1-800-344-4465 Call today!  
Fax Order Line  
1-800-344-6324

Call Today And **SAVE!** **Unbeatable PRICES!**

## CABLE TV

DESCRAMBLERS  
CONVERTERS • FILTERS  
VIDEO STABILIZERS

FREE ➤ 30 Day Trial  
FREE ➤ Product Catalog  
FREE ➤ 1 Year Warranty

100% MONEY BACK GUARANTEE



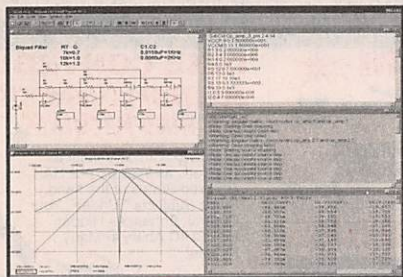
Let us point you in the right direction ...

**Arrow Technologies**  
Omaha, Nebraska

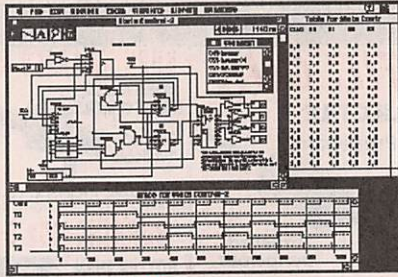
TOLL FREE  
888-554-ARROW  
888-554-2776



# CIRCUIT DESIGN FOR WINDOWS AND MACINTOSH



**B<sup>2</sup> SPICE**



**B<sup>2</sup> LOGIC**

B<sup>2</sup> SPICE and B<sup>2</sup> LOGIC are the best values in circuit simulation tools. They are used at over 100 major universities and many leading Fortune 500 companies including the University of Michigan, Stanford, AT&T, General Electric, and Motorola.

B2 Logic provides precise and customizable timing of individual pins on each device. No other program in this price range will help you catch as many timing glitches and violations. It also supports busses and subcircuits to facilitate the design of complex circuits.

B2 Spice integrates an intuitive interface with an optimized Spice engine. With a library of over 3000 parts, you will be able to find the part you need. In case you don't find it, you can easily import new parts into the libraries. The interface supports the full set of Spice3F5 simulations as well as Temperature and Parameter sweeps.



**Beige Bag Software**  
279 E. Liberty  
Ann Arbor • Michigan • 48104

**Phone** 734.332.0487  
**Fax** 734.332.0392  
**E-Mail** info@beigebag.com  
**Internet** www.beigebag.com

## B<sup>2</sup> SPICE

**\$249**

- Simulations: DC, Parameter, Dual, and Frequency Sweeps, Transient, Noise, Fourier, Transfer Functions, Pole-Zero, Distortion
- Spice 3F5 (32-bit)
- Over 3000 devices
- Over 30 parameterized devices
- Powerful graph interface
- Device and model parameter dialogs
- Run simulations directly from netlists

## B<sup>2</sup> LOGIC

**\$179**

- Subcircuits and subcircuit probing
- Precise customizable pin timing
- Over 100 components available
- Define new devices with equations and tables including state variables

## ELECTRONIC DESIGN PACKAGE

**\$279**

- Includes B<sup>2</sup> SPICE and B<sup>2</sup> LOGIC
- Demo Disks Available
- University & Student Prices Available
- Site Licenses Available
- Dealer Inquiries Welcome
- Visa/MasterCard Accepted

CIRCLE 304 ON FREE INFORMATION CARD

## Network Service Tool Set

Popular installation and service tools for networks, modems and telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin Ethernet (BNC), 8-position Token Ring, AT&T 258A and EIA/TIA 568A/B. Automatically scans cables for continuity, wiring sequence and polarization. Tests STP cable ground. Testing installed cables is easy with Remote Terminator and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

**Order No. 55625 \$197.00**

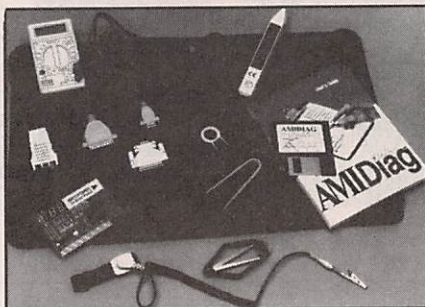


## PC Service Tool Set

Contains all tools needed to troubleshoot & service IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester
- Serial Adapter
- Serial & Parallel Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

**Order No. 55000 \$198.00**



## PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

**Order No. 55555 \$89.00**

## Network Installation Tool Set

- Network Tool Set 55625 without the Multi-Network Cable Tester.

**Order No. 55600 \$99.00**

Call for your **FREE Catalog**

**Graymark®**

P.O. Box 2015 Tustin, CA 92781  
<http://www.labvolt.com>

**CALL TODAY!**

**800-854-7393**



CIRCLE 329 ON FREE INFORMATION CARD



# AMAZING PRODUCTS!



## INFORMATION

VISIT OUR "ACTION" WEB SITE@  
UNLIMITED DEPT GEN+ 1198 <http://www.amazing1.com>  
BOX 716 AMHERST, N.H. 03031

### PLASMA BALLISTIC GUN

#### SHOOTS A HIGH VELOCITY PROJECTILE

Uses New Technology to Generate High Propellant Pressure Without Chemical Reactions

Velocities Up To 3000 m/sec with 50mg Projectile!!

Easily Scaled Up or Down

Easy to Build-Kit and Parts Available

Approximately .16 Caliber Bore

PPR01 Plans, Parts Lists and Sources.....\$20.00

Includes Our HEP Series Plans Used for RAILGUNS, COIL GUNS, EMP LEVITATION, ANTIGRAVITY, MASS WARPING, LATTICE SNAPPING etc



Labelled  
Dangerous

### BURNING LASER RAY GUN

BLASTS THRU THE HARDEST OF METALS!

All Parts Available

A FUTURISTIC CONCEPT!!

LAGUN2 Plans.....\$20.00

### BURNING CO2 BENCH LASER

HOTTER THAN MOST TORCHES!

Easy to Assemble

LC7 Plans.....\$20.00



### TAKE CONTROL!!

#### ELECTRONIC HYPNOSIS & MIND MACHINES

Electronic Circuitry Induces Hypnotic as Well as ALPHA Relaxed States of the Mind. Place Subjects "Under" Your Control. Enhances Hidden PSYCHIC Ability in Many People!

MIND Plans.....\$15.00

MIND2K Kit and Plans.....\$49.95

MIND20 Assembled.....\$89.95

### TELEPHONE TAPING SYSTEM

#### EXTENDED X4 PLAY

Tapes Both Sides of Phone Conversation - Check Laws!

TAP30X Ready to Use.....\$84.95

BEEP10 Beeper Alert.....\$29.95

### TRANSISTORIZED TESLA COIL

Turns A LIGHT BULB INTO A SPECTACULAR PLASMA DISPLAY

Transmits Wireless Energy. Brush and Corona Discharge. Noiseless Operation. Pyrotechnic Effect. 12 VDC/5 Amps or Battery 115 VAC Optional Converter. Adjustable Frequency Control For Effect.

Shown With Oil Fill Option

TCL5 Plans.....\$8.00

TCL5K Kit/Plans.....\$59.95

TCL50 Ready to Use.....\$109.95

12DC/7 12VDC@7Amps.....\$39.95

### JACOBS LADDER

Observe a pyrotechnical display of "traveling" fiery plasma. Starts off as 1/2" arc and expands to over 3" before evaporating into space. This is an excellent attention getting display as well as a winning science project!! With arc control.



JACK1 Plans.....\$8.00

JACK1K Kit Minus Case.....\$129.95

JACK10 Ready to Use.....\$249.95

12KVG20 Pwr Supply Only.....\$99.95

12KVG20K Kit of Pwr Supply.....\$79.95

### 3Mi FM VOICE TRANSMITTER

Safety Product Allows Listening to Children or Invalids in Hazardous Areas, Pools, Ponds etc. Great Security Intrusion Alert! Uses FM Table Top Radio. Become the local neighborhood D.J.



FMV1K Kit/Plans.....\$39.95

### ALL NEW CYBERNETIC EAR!

Enhances Normal Hearing 3 to 4 Times. Provides That Extra "Edge" for Hunters Trackers Nature Enthusiasts

Adjustable Volume Control Fits Into Either Ear Built In Long Lasting Batteries

CYBEREAR Ready to Use.....\$19.95

### MICRO TESLA COIL

Lights up a 4 ft Fluorescent Tube Without Contact!! Yet Only 3" Tall!



Super Magic Trick Low Cost Science Project 12 VDC/115 VAC Operation

MTC1K Kit/Plans.....\$19.95

MTC10 Ready to Use.....\$34.95

### PHASOR PAIN FIELD PISTOL

Blast out rats and rodents with high power Shock Waves Handheld and Battery Operated



PPPI Plans.....\$8.00

PPPIK Kit/Plans.....\$49.50

PPPI0 Ready to Use.....\$79.50

### HOVERBOARD PLANS

Kit Soon to be Available

28 Pages of "how to" build a magnetic force field capable of containing a column of ionized air up to several psi! Includes theory on how to build a HOVERBOARD prototype capable of lifting 200 lbs.

HOVER Plans and Data.....\$25.00

### Research Project



1 800 221 1705 ORDERS ONLY! FAX 1 603 672 5406 INFO 9-5pm 1 603 673 4730 FREE CATALOG ON REQUEST

Pay by MC, VISA, Cash, Chk, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for PROFORMA

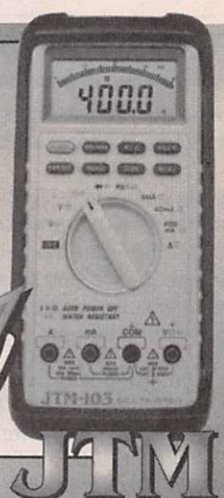
**JENSEN**  
JTK  
We don't copy Tool Kits... We create them!!  
A full line of meters worthy of the Jensen name!!  
**FREE CATALOG**  
800-426-1194  
Dept. 156

## A Full Line of Meters Worthy of the Jensen Name...

joins our lines of original JTK Tools Kits, test instruments, specialty tools, diagnostic equipment, PC & Lan accessories and more. Electronic technicians trust the Jensen name for everything they need to build, troubleshoot and repair their electronic projects.

- ✓ 100% Satisfaction Guaranteed
- ✓ 3 year manufacturer's warranty
- ✓ Same Day Shipping
- ✓ Free Technical Support
- ✓ 24 hours/7 days FaxBack® Service
- ✓ Secure Online Ordering

**NEW**



**JENSEN**

7815 S. 46th Street, Phoenix, AZ 85044  
Tel: 800-426-1194 Fax: 800-366-9662  
E-Mail: [jensen@stanleyworks.com](mailto:jensen@stanleyworks.com)  
Online: [www.jensentools.com](http://www.jensentools.com)

A Great Combination of Quality, Value and Service

CIRCLE 330 ON FREE INFORMATION CARD

### TODDS HOUSE OF FIBER

"Optical Fibers for Crafts, Hobbies & Electronics"

We carry Fiber optic fibers, Kits, Tools, Electronics, Sideglow, Endglow, Light Sources, Connectors, etc.

123 N. Main St. Brighton, Co 80601

Call: 303-659-5825

Send \$1 for Catalog

See our website at:

<http://www.toddsfiber.com>

On-Line Help Available

### CABLE EQUIPMENT

LOW, LOW WHOLESALE PRICES!

1-800-521-0512

New 1-piece Jerrold-5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.

New RFT-M -5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.

Basic Converter -5 units \$75/ea; 10 u. \$65/ea; 20 u. \$55/ea.

WHOLESALE ELECTRONICS

Check out our website: [www.whe.net](http://www.whe.net)

## BUGGED??

Eavesdropping is unbelievably widespread! Electronic Devices with amazing capabilities can be monitoring your telephone and room conversations RIGHT NOW! Are you sure you're safe? **FREE CATALOG** tells you fast! Includes Free Bonus details on fantastic opportunities now open in Counter-Surveillance field. Exciting, immensely interesting and EXTREMELY profitable (up to \$250 hr) full/part-time income. Call Now! 1-800-732-5000



# Mark V Electronics, Inc.

8019 E Slauson Ave  
Montebello CA 90640

Free Catalog 323/888-8988

Fax 323/888-6868

## DIY Audio Electronic Kits Enclosures & Transformers more than 60 items available!

http://www.mark5co.com Email: mark5co@aol.com  
ORDER 1-800-521-MARK / 1-800-423-FIVE

### 3 1/2" Digital LED Panel Meter #TY-43

It is a precision A/D converter integrated circuit. The display is a 6" LED for high visibility. It is easy to assemble and use the meter as a voltmeter, ammeter, ohmmeter, thermometer, frequency counter or capacitance meter. DC  $\pm 199.9$  mV full scale input 5-6VDC.

Kit: \$28.00 ~~15.00~~

### Fluorescent Light Driver #TY-2

This unit drives 6-40 watts fluorescent light for portable & emergency use. Works from a 7.2-16 VDC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights.

9.99  
Kit: \$78.75

### 300W MOSFET Power Mono Amp #AF-3

300W RMS into 4 ohms, 200W RMS into 8 ohms. Frequency response: 10Hz-20KHz THD < 0.03%. S/N 91 dB. Input Sensitivity & Load impedance at 1KHz, 1V 47K & 4-16 ohm. Power Requirement:  $\pm 55V$  -  $\pm 65V$  DC at 8A (each channel). A speaker protection circuit which provides time delayed speaker turn on.

132.00  
Kit: \$165.00

We accept Visa, MasterCard, Discover & Money Orders. Checks allow 2 weeks for clearance. We ship by UPS ground inside US (min \$5.00) and ship by US mail outside US. Please call for orders shipping & handling or fax (foreign) orders. In business since 1985.

### 20 Color LED Audio Level Meter #TY-13

Use this dual LED display indicating meter with your stereo power amplifier to indicate instantaneous speaker power. Operating range is -30dB to +5dB & can be calibrated to operate with 1-200W amplifiers. Not consume any amplifier power. A peak LED illuminates on overload!

Kit: \$23.50 9.99

### 40W Mini Stereo Multi-Input Amp #TA-83

Operated from AC source as well as 12V DC car battery. Used as a microphone PA amplifier while simultaneously mixing with an auxiliary input source such as CD & MD player.

Kit: \$30.50 24.40

### 120W + 120W Pre & Main Stereo Amp

It has provision for input program source switching, a phono pre-amp stage with RIAA equalization, 3-band tone controls, built-in power supply rectifier & filter & a speaker protection circuit. It only needs to be installed in a suitable housing & the addition of a power transformer in order to make it operational. #TA-800MK2

57.73  
Kit: \$67.92  
Asmb.: \$86.95

### Project Kits Source...

#TA-120 36W Class A Power Mono Amp \$32.50  
#TA-388 FET Class A Stereo Pre-Amp 64.00  
#TY-25 Stereo Loudspeaker Protector 16.75  
#KA-905 75-in-one Lab Kit 24.99

## Metal Cabinets

### Aluminium Front Panel

LG-1273 3x12x6 3/4" \$26.50  
LG-1684 4x16x8" 32.50  
LG-1924 4x19x11 1/2" 38.25  
LG-1925 5x19x11 1/2" 42.00  
LG-1983 2 1/2x19x8" 35.25  
LG-1923 3x19x11 1/2" 36.50  
LG-1927 7x19x11 1/2" 50.50  
LG- Black anodized rack cabinet

Best Buy

LL-1923B 2 1/2x19x12" \$69.50  
LL-1925A 5x19x12" 79.50

\*LL-Full Aluminum, Front .157" & other .078"

\*LL-Gold plated cap screw for front panel

### Power Transformer Toroidal Transformers

#001 28/30Vx2 6A \$30.00  
#002 36Vx2 3A 25.00  
#003 40Vx2 6A 32.00  
#004 24Vx2 6A 25.00  
#005 26Vx2 3A 19.00  
#006 18Vx2 5A 19.00  
#007 53Vx2 8A 47.00  
#008\* 28/30Vx2 6A 40.00  
#009\* 48/53Vx2 8A 66.00  
#010 30/36Vx2 400mA 8.50  
#011\* 9Vx2 22A 62.00  
#012\* 33/42Vx2 6A 48.00



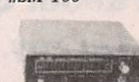
Transformer



\*Toroidal Transformer

### 150 Mhz 8 Digit Frequency Counter

#SM-100



Kit \$79.00 68.00  
Asmb \$99.00

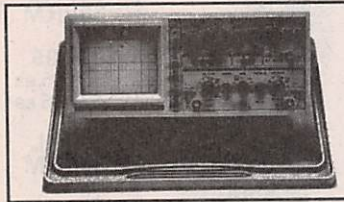
It is used for adjustment, test & repair of any kind of high frequency circuit products. It can give up to 8 digit of resolution for a wide frequency range 10Hz -150 MHz. The last input frequency can HOLD on the display for future reference & comparison. The circuit structure is compact & reliable for the most updated A/D LSI circuitry. The input impedance is 1M ohm.

CIRCLE 325 ON FREE INFORMATION CARD

# New and Pre-Owned Test Equipment



## Goldstar



Model OS-5100 → \$899.00

Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

Spectrum Analyzer  
Avcom PSA-37D

Satellite Downlink  
Installation  
Maintenance & Service

- Band 1 10 - 1750 MHz
- Band 2 3.7 - 4.2 GHz
- Built-In DC Block & Power for LNA/LNB's
- Line or Battery Powered

Only \$2,475.00!

We Buy Surplus  
Test Equipment

SIMCHECK® II PLUS  
Module Tester

- \* Tests SIMMs/168 p DIMMs
- \* Stand alone/portable
- \* Identifies Module properties
- \* Advanced Setup Capabilities

Only \$2750.00!

### Leader CATV Signal Level Meter Model LF 941

- ✓ TV/CATV Coverage from 46 - 870 MHz
- ✓ Video/Audio Carrier Measurements \$695.00!

Just Released! → "Series III" Multimeters

Fluke Model 87III \$319.00 !!!



TOLL FREE 1-800-99-METER

## Pre-Owned Oscilloscope Specials

Tektronix 2213	60 MHz	\$549.00
Tektronix 2215	60 MHz	\$649.00
Tektronix 465	100 MHz	\$599.00
Tektronix 465B	100 MHz	\$729.00
Tektronix 475	200 MHz	\$829.00
Tektronix 475A	250 MHz	\$999.00

- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- The Industry Standard of Oscilloscopes
- 1 Year Warranty - The Longest Available!!!

See us on the Web!

www.fotronic.com

## Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176

(781) 665-1400 • FAX (781) 665-0780

email: sales@fotronic.com

CIRCLE 333 ON FREE INFORMATION CARD





# Test Equipment Sales



Check out new **B&K PRECISION** and **INSTEK**!

B&K 5150 150 MHz 200MS/s DSO.....	\$4695	INSTEK GPC-3030 TRIPLE PS.....	\$450
B&K 2625 1 GHz SPEC. ANALYZER.....	\$2395	INSTEK GPC-3060 TRIPLE PS.....	\$875
B&K 2630 1 GHz SPEC. ANALYZER		INSTEK GUT-6000A DIG. IC TESTER.....	\$950
w/ TRACKING GENERATOR.....	\$3095	INSTEK GFC-8270 2.7 GHz COUNTER.....	\$795
B&K 1760 TRIPLE OUTPUT DC PS.....	\$595	INSTEK GOS-658G 50 MHz SCOPE	
B&K 1045B TELEPHONE PRODUCT TESTER.....	\$599	w/CURSORS & READOUT.....	\$795
B&K 898 SIMM TESTER.....	\$695	INSTEK APS-9100 1KW AC SOURCE.....	\$3450
B&K 560B PROG. PC BOARD TESTER.....	\$2750	INSTEK PEL-300G PROG. LOAD.....	\$1375
B&K 1260 NTSC SIGNAL GENERATOR.....	\$1795	INSTEK GPR-6015D 60V 15A PS.....	\$1995
B&K 2260 60 MHz SCOPE w/ C&R.....	\$1250	INSTEK LCR-815B LCR METER.....	\$1375
B&K 2615A 500 MHz SPEC. ANALYZER.....	\$1599	INSTEK GPS-3030D 30V 3A PS.....	\$295



Ask about our line of new products including  
**HP, LeCroy, Instek, Tektronix, Fluke and more!**



**CALL 800 684-4651 OR FAX (603) 425-2945**

**CHECK US OUT AT WWW.TESALES.COM**

CIRCLE 217 ON FREE INFORMATION CARD

## Miniature Transmitters and Receivers

### 2 Button / 3 Channel Transmitter



**RF300T**

1....\$22.95  
5....\$19.95 ea  
10....\$16.95 ea

**RF300XT**

1....\$25.95  
5....\$22.95 ea  
10....\$19.95 ea

- 300' (XT), 150' (T) Range
- Frequency: 318 MHz
- 59,049 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.8 ma
- Fully Assembled in Case
- Dimensions: 1.25" x 2.0" x .5"
- Push both buttons for the 3rd Channel
- Slide Button Cover Included

### 4 Button / 15 Channel Transmitter



**RF304XT**

1....\$27.95  
5....\$24.95 ea  
10....\$21.95 ea

- 250' Range
- Frequency: 318 MHz
- 6,561 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.6 ma
- Fully Assembled in Case
- Dimensions: 1.35" x 2.25" x .5"
- Push combination of buttons to achieve up to 15 channels

### 2-4 Data / 3-15 Channel Receivers



**RF300RL  
RF300RM**

1....\$27.95  
5....\$24.95 ea  
10....\$22.95 ea

**RF304RL  
RF304RM**

1....\$29.95  
5....\$26.95 ea  
10....\$23.95 ea

- Compatible with 300/4 Transmitters
- 11-24 volts DC Operating Voltage
- 13 ma. Current Draw
- Latching (L) or Momentary (M) Output
- Kits Available (subtract \$5.00 ea.)
- Dimensions: 1.25" x 3.75" x .5"
- 2 (300) / 4 (304) Output Data Lines
- Binary to Dec / Hex Converter can achieve up to 15 channels

- Alarm Systems
- Garage / Gate Openers
- Lighting Control

- Magic Props
- Medical Alert
- Monitoring Systems

- Industrial Controls
- Surveillance Control
- Motor Control

- Schematics Available
- Receiver Board Layout Available
- Custom Design Consulting Available

**Visitect Inc.**

(510) 651-1425 Fax: (510) 651-8454  
P.O. Box 14156, Fremont, CA 94539

Email: [Support@Visitect.Com](mailto:Support@Visitect.Com)  
Visa / Mastercard, COD

CIRCLE 310 ON FREE INFORMATION CARD



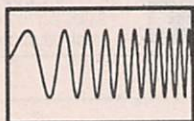
# Any waveform you want!



## New Features:

- ✓ 21.5 MHz
- ✓ .01 Hz steps
- ✓ multi-unit phaselock

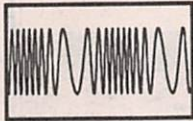
### Telulex Inc. model SG-100A



DC to 21.5 MHz linear and log sweeps



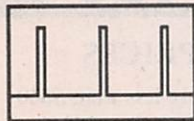
Int/Ext AM, SSB, Dualtone Gen.



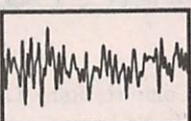
Int/Ext FM, PM, BPSK, Burst



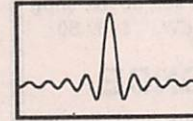
Ramps, Triangles, Exponentials



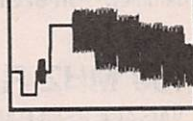
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

## ● Synthesized Signal Generator

Clean sinewaves DC-21.5 MHz, .001% accuracy! .01 Hz steps. DC Offset. RS232 remote control.

## ● Arbitrary Waveform Generator

40 Megasamples/Second. 32,768 points. 12 bit DAC

## ● Function Generator

Ramps, Triangles, Exponentials & more to 2 MHz!

## ● Pulse Generator

Digital waveforms with adjustable duty cycle

**Telulex Inc.**

2455 Old Middlefield Way S Tel (650) 938-0240 <http://www.Telulex.com>

Mountain View, CA 94043 Fax (650) 938-0241 Email: [sales@Telulex.com](mailto:sales@Telulex.com)

CIRCLE 311 ON FREE INFORMATION CARD

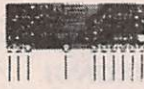
## RF Data Modules

### AM Transmitter



- Sub Miniature module
- SAW Controlled
- No adjustable components
- Low current - 2.5mA
- Supply 2.5-12Vdc
- 418MHz or 433MHz
- Range up to 300ft
- CMOS/TTL data input
- 7 x 11 x 4mm !
- AM-TX1-xxx .... \$12.60

### AM Receiver



- Compact Hybrid Module
- Very stable
- CMOS/TTL output
- Patented Laser Trimmed
- 5Vdc, 0.8mA (HRR6)
- 2kHz data rate
- Sensitivity -105dBm
- 38 x 12 x 2 mm
- AM-HRR6-xxx.... \$16.33

### FM Transceiver



- Only 23 x 33 x 11mm
- Up to 40,000bps data rate
- Up to 450ft. range.
- 5V operation
- 418MHz or 433MHz FM
- 5V CMOS logic interface
- Fast 1mS enable
- Power saving feature
- Carrier Detect output
- BiM-xxx-F ..... \$87.36

### RS232 Transceiver



- 3wire RS232 interface
- 19.2Kbps half duplex
- 418MHz or 433MHz FM
- 7.5-15Vdc, 20mA
- TX/RX Status LED's
- Up to 400ft. range
- 1/4 wave ant. on board
- User data packetizing
- 58 x 40 x 15mm
- CYPHERNET .... \$139.30

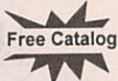
### AM Transmitter



- Range up to 250ft.
- SAW controlled stability
- Wide supply range 2-14V
- CMOS/TTL input
- Low current. 4mA typ.
- Up to 4kHz data rate
- Small: 17 x 11mm
- AM-RT5-xxx .... \$12.10



**ABACOM**  
TECHNOLOGIES



tel: (416)236 3858  
fax: (416)236 8866  
[www.abacom-tech.com](http://www.abacom-tech.com)  
MasterCard / VISA

## Learn to Hack!



Finally, here is a no-nonsense technical book on computer hacking! In it you will learn how to hack computers you have physical access to and how to hack on the Internet. With this book, you will learn about:

*Finding computers to hack*  
*Breaking into computers*  
*Hacking with Finger*  
*Port surfing*  
*Mapping the internet*  
*Forging E-mail*  
*Fighting spam*  
*E-mail bombs*  
*Hacker wars*

and more! But this book will also teach you how to hack safely. It will steer you clear of the law, so that your hacking career won't lead to prison, but to a better job! **By far, the best book on hacking available today!**

**400 PAGE PAPERBACK, \$34.95 SHIPPING \$3**

**Call (800)719-4957 now!**

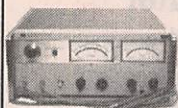
to order (Visa/MC/COD) or call or write for **FREE CATALOG** of hard-to-get information about computer viruses, computer hacking, security and cryptography!!

Check our web site: [www.logoplex.com/resources/ameagle](http://www.logoplex.com/resources/ameagle)  
**American Eagle Publications, Inc.**  
P. O. Box 1507, Dept E.  
Show Low, AZ 85902

CIRCLE 270 ON FREE INFORMATION CARD



## VECTOR VOLTMETER



**HEWLETT-PACKARD 8405A VECTOR VOLTMETER**, measures by both magnitude and phase over 1 to 1000 MHz in 21 overlapping bands. Also capable of determining insertion loss, group delay of bandpass filters, complex impedance of mixers and antennas, RF distortion and in-circuit probing. Ranges: 100 uv to 1 V-rms full scale in 10 db steps. Phase: 360 degrees on 0-center meter with end scale ranges +/- 180, 60, 18 and 6 deg. Band-width: 1 KHz. Requires 115/230 VAC50-400 Hz; 7x16.8x18.4, 36 lbs USED-reparable, \$295

## 30 FOOT MAST KIT

**AB-1244/GRC MAST KIT**, twelve aluminum alloy on steel sections form sturdy, yet lightweight 30 foot 1.7" dia mast. Kit includes five each lower and upper sections, one ea lower and upper adapter sections, gin pole swivel base, four ea 36 and 42 ft guy ropes, four guy stakes, two guy rings plus a 2.5 pound sledge hammer. Part of OE-254 antenna set; 30 lbs shpg  
NEW, \$139.50



## 400 MHZ RADIOSONDE



**VAISALA RS80 RADIOSONDE**, ultra-light disposable transmitter (400 MHz approx) is designed to be carried aloft by weather balloon and transmit data for air temperature, barometric pressure and humidity to a ground station. Consists of circuit board, dipole antenna, and trailing wire. Requires 9 V battery. Cute experimenter item! 12.5"H as shown; 3 lbs sh.  
NEW, \$9.95 ea; 5 for \$42.50

Prices F.O.B. Lima, Ohio. VISA, MASTERCARD, DISCOVER  
Allow for shipping charges. Write for latest Catalog.  
Address Dept. ES + Phone 419/227-6573 + FAX 419/227-1313  
E-mail: fairadio@wcoil.com http://www2.wcoil.com/~fairadio

## FAIR RADIO SALES

1016 E. Eureka + Box 1105 + Lima, Ohio 45802

## Carpet Rover Kit

\$115.00 Plus S&H



### You can build this Mobile Robot

This easy to build mobile robot base is an excellent foundation for many different robotic experiments. The large 3" wheels handle rough terrain. Use the robot for demonstrating bumper switch or IR obstacle avoidance, maze negotiation, line following, light following, beacon locating, robot sumo, and robot art, to name a few. The kit includes the hardware, structural components, Hitec servos, wheels, First Step micro, software, and an illustrated assembly manual. It's a lot of fun to build and even more fun to operate.



Shown with the IRPD, no contact obstacle detector.

We have many more cool robots, check out our web page or ask for our free catalog!

Lynxmotion, Inc.  
104 Partridge Road  
Pekin, IL 61554-1403  
www.lynxmotion.com



Tel: 309-382-1816  
Fax: 309-382-1254  
sales@lynxmotion.com  
tech@lynxmotion.com

# LASERS

## AT GREAT PRICES

Complete Ruby Laser Assembly less than \$300  
He-Ne Lasers, complete, for less than \$50  
American 60X Argon Lasers from \$595  
Laser Diode Modules from under \$40  
X-Y Scanners from \$79

## FREE CATALOG

- Helium-Neon
- Argon Lasers
- Diode Lasers
- Holography
- Books
- Ruby Lasers
- Scanners
- Lightshow Equipment
- Pointers
- Optics

Email: mlp@nlenx.com http://www.midwest-laser.com



## Midwest Laser Products

P.O. Box 262, Frankfort, IL 60423  
Phone: (815) 464-0085 FAX: (815) 464-0767

30 Day Satisfaction  
Guarantee.

VISA / MC Accepted

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401  
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM  
WE BUY TEST EQUIPMENT AND COMPONENTS.  
VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 51501A 100MHZ DIGITIZING SCOPE	\$1300.00	HP 4935A TRANS. IMPAIRMENT TEST SET	\$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	\$1000.00	HP 5006A SIGNATURE ANALYZER	\$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	\$1000.00	HP 86602B 1MHZ-1300MHZ RF PLUG	\$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	\$700.00	EIP 575 MICROWAVE COUNTER	\$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	\$250.00	FLUKE 95 50MHZ SPECTROMETER	\$550.00
HP 5370A 100MHZ U.T.I. COUNTER	\$400.00	LECROY 7200 400MHZ O-SCOPE	\$1000.00
HP 3586C LEVEL METER	\$750.00	TEK 475 200MHZ O-SCOPE	\$500.00
HP 436A POWER METER W/O SENSOR+CABLE	\$500.00	TEK 465 100MHZ O-SCOPE	\$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC ANALYZER	\$3500.00
HP 3437A 3.5DIGIT SYSTEM VOLT METER	\$250.00	TEK 1240 LOGIC ANALYZER	\$750.00
HP 3455A DIGITAL MULTIMETER	\$250.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	\$1400.00
HP 3456A DIGITAL MULTIMETER	\$400.00	TEK 11401A 500MHZ PROG O-SCOPE FRAME	\$750.00
HP 3336C SYNTHESIZER/LEVEL GENERATOR	\$800.00	TEK 7854 400MHZ OSCILLOSCOPE FRAME	\$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	\$250.00
HP 5335A 200MHZ COUNTER	\$600.00	TEK 7A26 200MHZ VERTICAL PLUG	\$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	\$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	\$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	\$1090.00	TEK 7B80 400MHZ TIME BASE	\$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	\$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	\$125.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	TEK 7512 SAMPLING PLUG	\$250.00
HP 6034A 60VDC-10A POWER SUPPLY	\$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	\$1000.00
HP 6209B 40VDC-50A POWER SUPPLY	\$800.00	TEK AM503 CURRENT PROBE AMPLIFIER	\$250.00
HP 6553A 40VDC-12.5A. POWER SUPPLY OPT.J01	\$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	\$400.00
HP 6632A 20VDC-5A POWER SUPPLY	\$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	\$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT.J03	\$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	\$1100.00

## KEEP YOUR C-BAND SYSTEM RUNNING STRONG!

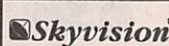
### Free Buyer's Guide

#### BEST VALUES ON...

- Receivers, including 4DTV
- Dish Movers & LNBs, all kinds
- Tune-up Kits, Tools & Parts
- Skypac® Programming
- Toll Free Technical Help

Fax: 218-739-4879 1010 Frontier Dr.  
Int'l: 218-739-5231 Fergus Falls, MN 56537

800-543-3025  
www.skyvision.com



New!

Low Cost, Precision-Made  
**PC BOARDS**  
From Your Gerber/NC Drill Files



www.pcbmilling.com FAX: (703) 818-0071

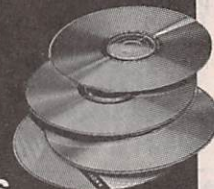


# A Trained Computer Repairman Charges \$100 An Hour and More... You Can Get That Training!

Foley-Belsaw's Totally New  
Computer Repair Course  
gives you the skills to  
start earning top pay  
**FAST!!!!!!**

You get these Foley-Belsaw  
Exclusives! At no extra cost!

- A+ Certification Test Preparation Tutor™
- Foley-Belsaw CD-ROM Learning Assistant™
- Business Start-up Resource



## SPECIAL BONUS

Inquire now and your course will come with a complete video archive library of early printer and computer repair techniques... at no additional cost.



## No Experience Necessary!

Get "hands-on" training in the exciting field of computer repair.

## Train At Home!

There's not a more complete—or affordable—PC Repair course that will have you trained and job ready in such a short time.

**Take the first step to top pay.  
Call for a FREE Opportunity Kit today!  
1-800-487-2100**

**Fully illustrated, easy to understand course gives you everything you need to succeed.**

The key to your success lies in providing a service that is in great demand. Even if you have no experience, you can become an expert in a few short months. Foley-Belsaw's computer repair course is broken into small, easy to manage lessons. Each lesson is designed with your success in mind. After you complete the course, you'll have the expert knowledge to earn up to \$100 an hour, or more!

**Latest technologies and insider knowledge available only to Foley-Belsaw students!**

Get the "hands-on" experience you need in Computer Repair. Foley-Belsaw's CD-Rom Learning Assistant™ guides you through each lesson and is always right at your fingertips. The Test Preparation Tutor™ makes preparing for your A+ Certification as easy as turning on your computer. Foley-Belsaw's inside knowledge gives you the practical experience to become a computer repair professional. Get started today!



World leader in training since 1926, provides at-home, "hands-on" training in high-demand fields.

or complete this coupon and mail to Foley-Belsaw Institute, 6301 Equitable Road, Kansas City, MO 64120-1395

☐ **Yes!** Send me one of the following **Free** Opportunity Kits:

- ☐ Computer Repair, Maintenance, Upgrade, Dept. 64800
- ☐ Personal Computer Specialist, Dept. 38436
- ☐ Professional Computer Programming, Dept. 35616
- ☐ Professional Saw and Tool Sharpening, Dept. 22002
- ☐ VCR/DVD Service and Repair Dept. 62898
- ☐ Small Engine Service and Repair, Dept. 53071
- ☐ TV/Satellite Dish Service and Repair, Dept. 31669
- ☐ Professional Gunsmithing, Dept. 92708
- ☐ Home Inspection, Dept. 76116
- ☐ Networking Specialist, Dept. 39423
- ☐ Locksmithing, Dept. 13198
- ☐ Woodworking, Dept. 43934
- ☐ Upholstery, Dept. 81606
- ☐ Vinyl Repair, Dept. 71531
- ☐ Electrician, 95477

**Satisfaction  
Guaranteed**  
Foley-Belsaw gives you  
a Free 30-Day Trial.  
Be careful!  
Most schools charge \$150.00  
for this privilege.

Name \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

Phone ( ) \_\_\_\_\_

PC  
PLACE

March 1999, Electronics Now

83



# 386 MINI-PC \$83

1K PRICE  
EVAL \$295  
8088 \$27



- includes:
- 5 Serial, 3 Parallel (32bit max)
  - Up to 8 meg ROM (27C080)
  - 32k RAM exp. to 64Mbyte
  - Battery backed RT Clock
  - LCD and Keyboard ports
  - IRQ x15, DMA x2, TIMER x4
  - On-board LED display
  - Industry Standard PC Bus

Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

## A to D D to A CONVERTERS

For PC or SBC  
8,12,16 bit resolution  
up to 24 channels  
starting at \$21 OEM (1k)  
eval kit \$75

## \$95 UNIVERSAL PROGRAMMER

FLASH, EEPROM, NVRAM, EPROM  
up to 8 meg (27C64-080). Adapters for  
micros, PLCC, etc. Parallel port version  
for notebook. FAST AND EASY TO USE.



LOW COST... LOW POWER...

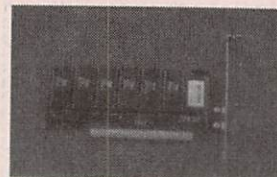
## LOW RISC!

QTY 1K PRICE  
\$1.99  
EVAL KIT 7.00

LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

COMPARE:	16C54	MV1200	PINOUT:
OEM (1K) PRICE	\$2.57	\$1.99	
RS232 PROGRAM DOWNLOAD	NO	YES	RESET 1 20 VCC
SINGLE CHIP OPERATION	NO	YES	PD0 2 19 PB7
BUILT-IN BASIC	NO	YES	PD1 3 18 PB6
EEPROM DATA MEMORY	NONE	64	XOUT 4 17 PB5
PROGRAM MEMORY	768 OTP	1K FLASH	XIN 5 16 PB4
MATH REGISTERS	1	32	PD2/INT 6 15 PB3
MAX INSTRUCTIONS / SEC	5M	20M	PD3 7 14 PB2
MAX COUNTER BITS	16	18	PD4/TMR 8 13 PB1/AD1
INPUT / OUTPUT BITS	12	15	PD5 9 12 PB0/AD0
A TO D COMPARATOR	NO	YES	GND 10 11 PD6
HARDWARE INTERRUPTS	NONE	3	

- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -



## PC SOLID STATE DISK

\$21 OEM (1k) eval kit 75.00  
FLASH / RAM / EPROM  
256K-16M PCMCIA/DIPS

## No More Hangups... PC WATCHDOG!

Reboots PC OEM \$21 EVAL \$75



## VGA LCD



visit our web site: [www.mvsweb.com](http://www.mvsweb.com)

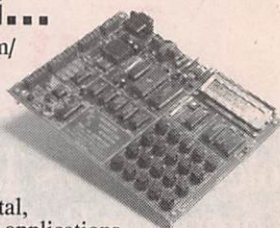
MVS BOX 850  
MERRIMACK, NH 03054  
(508) 792-9507



5yr Limited Warranty  
Free Shipping  
Hrs: Mon-Fri 10-6 EST

## Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/  
embedded control system.  
Extensive manuals guide you  
through your development  
project. All programming and  
hardware details explained.  
Complete schematics. Learn to  
program the LCD, keypad digital,  
analog, and serial I/O. for your applications.



THREE MODELS AVAILABLE. Choose from an  
Intel 8051, Intel 8088, or Motorola 68HC11  
based system. All models come with:

- 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.  
Money Back Guarantee

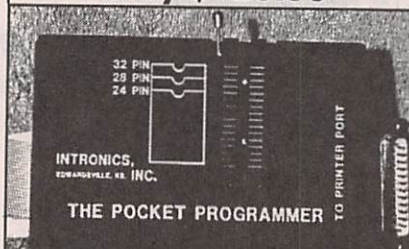
Call for Free Info Pack, or see  
WEB at <http://www.aesmicro.com>  
714-550-8094, FAX 714-550-9941



Call 1-800-730-3232

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA

## The Pocket Programmer Only \$129.95



The portable programmer that uses  
the printer port of your PC instead of  
a internal card. Easy to use  
software that programs Eprom,  
EEprom, Flash & Dallas Ram. 27(C)  
/ 28(C) / 28F / 29F / 29C & 25XX  
series from 16K to 8 Megabit with a  
32 pin socket. Adapters available for  
Pic, PLCC, 5-Gang, 874X, 875X  
MCU's, 40-Pin X 16 & Serial  
Eprom's, 82/74 Prom's and Eprom  
Emulator to 32K X 8.

Same Name, Address & Phone #  
for 16 Years... Isn't it Amazing ?

## Intronics, Inc.

Box 13723 / 612 Newton St.  
Edwardsville, KS 66113 Add \$5.00 COD  
Tel. (913) 422-2094 Add \$4.00 Shipping  
Fax (913) 441-1623 Visa / Master Charge

Whaddya Say To  
A Guy Who's Had  
The Same Job  
For 50 Years,  
Has Never Called  
In Sick Or  
Showed Up Late,  
Never Taken A  
Vacation Or A  
Holiday, Never  
Asked For A  
Raise Or Griped  
About His Bonus  
And, Believe It Or  
Not, Has No  
Plans For  
Retirement?



Thanks.

Remember - only you can prevent forest fires.



## Electronic CAD for Windows

Professional Windows EDA tools at an affordable price with powerful features to make designing faster. WinBoard PCB layout delivers sophisticated interactive routing for complex designs, plus it has the tools needed for high-speed circuits, analog, RF and SMT designs.

### WinDraft® Schematics

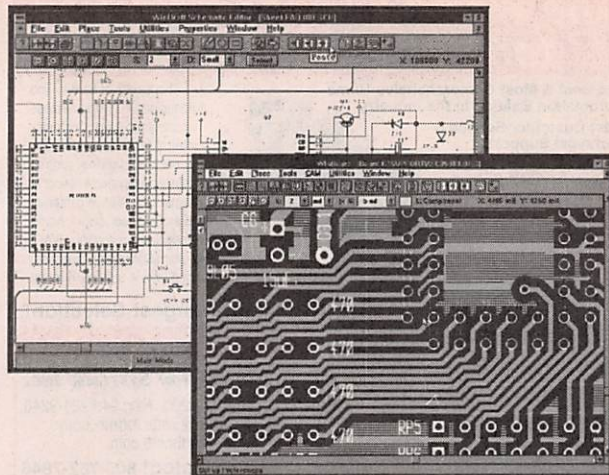
- ◆ Use True-Type fonts. Quickly copy and paste into other applications.
- ◆ Supports hierarchical designs, electrical rules checking, Annotation & Bill of Materials.
- ◆ Thousands of library parts and symbol editor included.

### WinBoard™ PCB layout

- ◆ Supports 16 layers, multiple copper pours, and advanced features for RF designs.
- ◆ SMD & through hole library with on-line graphical editor.
- ◆ CAM outputs include BOM, in-circuit test, NC Drill, Gerber, Pick & Place, & Advanced Design Rule Checking (DRC).

With our unique **pin capacity** versions you only pay for what you need. You choose the base configuration to suit your needs today, and expand that configuration to handle increased pin capacity as your design requirements change.

**WinDraft 2.0 Available Now**



- \$ 250 WinDraft or WinBoard - P650
- \$ 495 WinDraft or WinBoard - unlimited
- \$ 895 WinBoard P650 with CCT Spectra® autorouter.

Thousands of satisfied customers are using this new generation of powerful and affordable Windows EDA tools from Ixex. Your satisfaction is guaranteed!

**World Wide Web: <http://www.ixex.com>**

Information and free evaluation version is available on the Ixex WW Web, FTP and BBS.

Tel: (503) 531-3555  
Fax: (503) 629-4907  
BBS: (503) 645-0576



Ixex Design International. 15232 NW Greenbrier Parkway. Beaverton, Oregon 97006. USA.

ADV2\_1

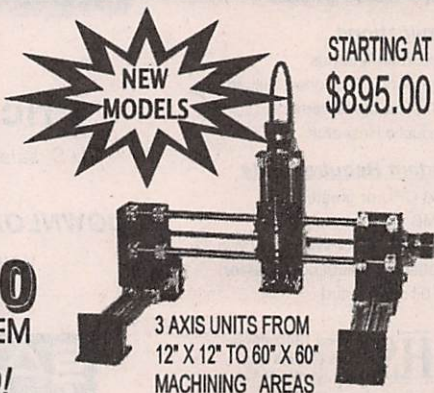
CIRCLE 319 ON FREE INFORMATION CARD

## CAD FILES TO CASH PILES



IMAGINE THE POSSIBILITIES!  
ROUTE, MILL, DRILL, CARVE,  
ENGRAVE, PAINT, ETC. ....  
IN WOOD, PLASTIC, VINYL,  
PC BOARD, & LIGHT METALS.

THE **ROBOPRO X50**  
CNC ROBOTIC MACHINING SYSTEM  
YOUR WISH IS ITS COMMAND!



Visit us at  
[www.uscyberlab.com](http://www.uscyberlab.com)

U. S. CYBERLAB, INC., 14786 SLATE GAP RD., WEST FORK, AR 72774  
VOICE (501) 839-8293 / 24 HR. FAX BACK (501) 839-8293



## The World's Largest Source for Home Automation

- The Best & Most Comprehensive Home Automation Catalog in the Industry
- Best Customer Service & Technical Support

**FREE**  
160 page full  
color catalog!

Thousands of hard-to-find automation, X-10 and wireless control products. Computer interfaces, software development tools, lighting control, telephone systems, security systems, surveillance cameras, infrared audio/video control, home theater, touchscreen control, HVAC, pet care automation, wiring supplies, books and videos and much more!

**World's Largest Selection!**

**Lowest Prices Guaranteed!**

**HOME AUTOMATION SYSTEMS, INC.**

Questions: 949-221-9200 Fax: 949-221-9240

e-mail: catalog@smarthome.com

www.smarthome.com

Call for a **FREE** Catalog! 800-762-7846

**800-SMART-HOME**

Dealers/Resellers ask about our

SmartHome PRO Dealer Program 800-949-6255





**SUPPORTS DEVICES TO 32 MEG**

# EPROM+

A device programming system for design, repair and experimentation

- ◆ EXCEPTIONAL POWER FOR THE PRO
- ◆ EASY-TO-USE FOR THE NOVICE
- ◆ INCLUDES STEP-BY-STEP TUTORIAL

**Here's what you get:** A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters.\* Comprehensive, easy-to-use software which is specifically designed to run under DOS. Windows 3.1, 95 and 98 on any speed machine. The software has features which let you READ, PROGRAM, COPY and COMPARE plus much more. You have full access to your system's disk including LOADING and SAVING chip data plus automatic processing of INTEL HEX, MOTOROLA S-RECORD and BINARY files. For detailed work the system software provides a full screen buffer editor including a comprehensive bit and byte tool kit with more than 20 functions.

**Broad device support:** FIRST GENERATION EPROMS (2708, TMS2716\*, 25XX) SECOND GENERATION EPROMS (2716-28C080), 40 AND 42 PIN EPROMS\* (27C1024-27C160) FLASH EPROMS (28F29C-29EE-29F), EEPROMS (2816-28C010), NVRAMS (12XX.X2210/12) 8 PIN SERIAL EPROMS\* (24, 25, 85, 93, 95, 80011A) PLUS ERI400/MS8657\* AND ER5901 BIPOLAR PROMS\* (72S/82S), FPGA CONFIGURATORS (17CXXX) MICROCONTROLLERS\* (874X, 875X, 87C5XX, 87C75X, 89C5X) ATMEL MICROS\* (8-40) PIN 89CXX01, 89SXXX (AVR) 90SXXX PIC MICROS\* 8, 18, 28, 40 PIN (12CXXX-16CXXX, 16FXX, 17C) MOTOROLA MICROS\* (68705P3/J3/R3, 68HC705, 68HC711)

**\$289**

\*REQUIRES SNAP-IN ADAPTER (FOR ERI400/MS8657 OR BUILD YOURSELF) \$5.00 SHIPPING + \$5.00 C.O.D. 1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE VISA\*MASTERCARD\*AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150  
(513) 831-9708 FAX (513) 831-7562 website - www.arlabs.com

## CABLE TV CONVERTERS

Equipment & Accessories  
Wholesalers Welcome

Call C&D ELECTRONICS  
1-888-615-5757 M-F 10a-6p

# POPTRONIX®

Awaiting your call!

Online  
Edition

<http://www.poptronix.com>

## Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

### Features

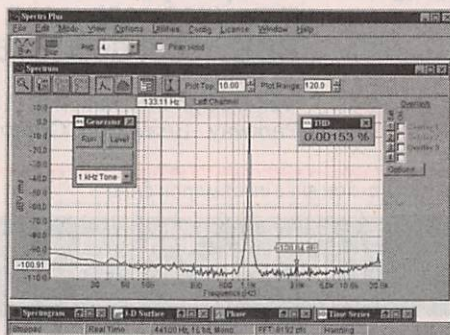
- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

### Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

### System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card



**Priced from \$299**

(U.S. sales only - not for export/resale)

**DOWNLOAD FREE 30 DAY TRIAL!**

[www.spectraplus.com](http://www.spectraplus.com)

**PHS** Pioneer Hill Software  
24460 Mason Rd.  
Poulsbo, WA 98370  
a subsidiary of Sound Technology, Inc.

Sales: (360) 697-3472



**Spectra Plus**  
FFT Spectral Analysis System

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

## Battery Analyzer



### PC-Controlled Battery Analyzer

Cycle, Charge & Test with your PC  
Print reports, plot graphs, expandable

**\$398**



Tel: 800-673-3585  
519-472-5566  
Fax: 519-472-1702

**LaMantia Products Ltd.**

Download Demo:  
<http://home.rogerswave.ca/lamantia>  
[lamantia@compuserve.com](mailto:lamantia@compuserve.com)

## PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAM'S DATA I/O ICE TECHNOLOGY HILO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SIP TESTER EMUPA

CALL ADVANTECH LABTOOL	599 EETOOLS SIMMAX
629 ICE TECH MICROV	795 CHROMA SIMM/SIP
650 EETOOLS ALLMAX +	359 MOD-MCT-EMUPA/R
409 EETOOLS MEGAMAX	279 MOD-MCT-EMUP/R
509 EETOOLS MEGAMAX4	49 EPROM 1G TO 512K
369 XELTEK SUPERPRO II	69 EPROM 1G TO 1MEG
409 XELTEK SUPERPRO II P	99 EPROM 4G TO 1MEG
249 XELTEK SUPERPRO L	199 EPROM 16G TO 1 MEG
165 XELTEK ROMMASTER II	89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA	129 EPROM 4G TO 8MEG
739 STAG ORBIT-32	250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

### General Device Instruments

Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234  
Web [www.generaldevice.com](http://www.generaldevice.com) E-Mail [icdevice@best.com](mailto:icdevice@best.com)

# ELECTRONIC SHOPPER



2539 W. 237th Street, Bldg. F, Torrance, CA 90505  
 Order desk only: USA: (800) 872-8878 CA: (800) 223-9777  
 LA. & Technical Info: (310) 784-5488 Fax: (310) 784-7590  
 OEM INQUIRIES WELCOME

## TIMELINE INC.

Over 13 years and 31,000 customers and still growing

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers checks, MC or VISA. No personal checks or C.O.D.s. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

### LIQUID CRYSTAL DISPLAYS

#### 240x64 dot LCD with built-in controller.

AND 4021ST-EO. Unit is EL back-lit. \$59.<sup>00</sup> or 2 for \$109.<sup>00</sup> or  
 OPTREX DMF5005 (non back-lit) \$49.<sup>00</sup> or 2 for \$89.<sup>00</sup>

20 character x 8 line 7HL x 2.5H The built-in controller allows you to do text and graphics.

#### Alphanumeric—parallel interface

16x1	\$7.00	20x2	\$10.00	32x2	\$8.00
16x1 (lg. char.)	\$10.00	20x4	\$15.00	40x1	\$8.00
16x2	\$7.00	20x4 (lg. char.)	\$10.00	40x2	2 for \$20.00
16x2 (lg. char.)	\$10.00	24x2	\$10.00	40x4	\$20.00
16x4	\$15.00	32x4	\$10.00	4x2	\$5.00

5V power required • Built-in CMOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are backlit, call for more info.

#### Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

#### 6" VGA LCD 640X480, Sanyo LMDK55-22 \$25.<sup>00</sup>

### MONITORS

#### Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15KHz • Ability to do 40 and 80 column.  
 5 inch Amber \$25.00 • 7 inch Amber \$25.00  
 9 inch Amber or Green \$25.00

#### 5" COLOR MONITOR \$39.<sup>00</sup>

- Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
- 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
- Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

2 for \$69.<sup>00</sup>

#### 9" COLOR SVGA MONITOR \$179.<sup>00</sup> Fully Enclosed - Tilt and swivel type.

### POS & BAR CODE

#### MAGNETIC CARD READER \$25.<sup>00</sup>

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypad with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBSC 2300) \$19.00

### HACKER CORNER

#### EMBEDDED 486 COMPUTER \$99.<sup>00</sup>

Complete enhanced Intel 486SX-33 based computer in ultra small (9.7HL x 6.58W x 3.18H) case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

#### SONY Miniature Color LCD Display (LCX005BKB) \$29.<sup>00</sup>

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built in Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality • 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

#### CELL SITE TRANSCEIVER \$49.<sup>00</sup> 2 for \$89.<sup>00</sup>

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier, channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 28 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

#### Encased Spread Spectrum RF Modem \$99.<sup>00</sup>

The ProxLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProxLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmission at rates up to 19.2 Kbaud (full duplex) over a range of 500 - 800 feet. Modules use 900 MHz spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProxLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub - D) interface, and small (~4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available. These are 100 Mw power.

#### COLOR CCD CAMERA \$89.<sup>00</sup>

Small fully enclosed color CCD camera ideally suited for video conference and mobile operations. No separate power supply or batteries needed - single 5 VDC power requirement can be obtained from PC keyboard interface or directly from the computer using the included adapter plugs. Standard NTSC composite output from 1/4" color CCD sensor with 250,000 pixels and automatic white balance.

CIRCLE 275 ON FREE INFORMATION CARD

## MICROTEST INC. CABLE TEST CHIPS FROM \$9.95

WE STOCK A COMPLETE LINE OF CHIPS  
 WE ALSO HAVE CRYSTAL 119.MHZ117.MHZ

### WARNING:

ANYONE IMPLYING ILLEGAL USE WILL BE DENIED SALE. WE SELL PRODUCTS ONLY TO TECHNICIAN OR REPAIR FACILITIES ALL ORDERS SHIP VIA UPS/ECT THE BEST PRICE IN THE MARKET WE INCLUDE SWITCH & RESISTOR MON-SAT 8 AM-7 PM EST .TECH SUPPORT E-MAIL WWW.MICRO-TEST@AOL.COM

FOR ORDERS  
 1800-931-9440

### EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- [www.m2l.com](http://www.m2l.com)

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE

and Flash (28F,29C) to 32 pins

Inexpensive - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

#### Available Adapters

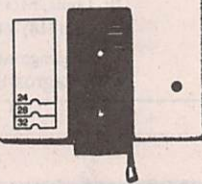
EP-PIC (16C5x,61,62x,71,84)	\$49.95
EP-PIC64 (62-5,72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-11 (8751, C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC711D3)	\$39.95
EP-16 (16bit 40pin EPROMs)	\$49.95
EP-Z8 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (IC722x10, 16v8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95

#### Many Other Adapters Available

#### M<sup>2</sup>L Electronics

970/259-0555 Fax: 970/259-0777  
 361 S Camino Del Rio Suite #119, Durango,  
 CO 81301; CO orders add 7% sales tax.  
<http://www.m2l.com>

EZ-EP  
 M<sup>2</sup>L ELECTRONICS  
 Los Angeles, California



**SINGERS! REMOVE VOCALS**  
 Unlimited, Low Cost, Instantly Available  
 Background Music from Original Standard  
 Recordings! Does Everything Karaoke  
 does... Better and gives you the  
 Thompson Vocal Eliminator™  
 Free Brochure & Demo Tape.  
 LT Sound Dept EN  
 7988 LT Parkway, Lithonia, GA 30058  
 Internet: <http://www.LTSound.com>  
 24 Hour Demo/Info Request Line (770) 492-2485 - Ext 72  
 When You Want Something Better Than Karaoke!

## POPTRONIX®

Awaiting your call!

Online  
 Edition

<http://www.poptronix.com>



To learn more about life-saving techniques,  
 call your Red Cross.





Since 1971

**www.WEB-TRONICS.com**

You'll  
"Bookmark"  
This Site!

**Circuit  
Specialists  
Inc.**

**B/W Board Camera  
with Infra-Red  
ONLY \$59**  
Part #VMC8-21  
And that's not all!



**Full-Sized, Full Featured  
DMM  
ONLY \$19**  
Part #9300G  
Even includes the  
rubber boot



**Hard Drive  
Slide Rack  
for 3.5" IDE  
Drives  
ONLY \$14.95**  
Part #RH-10C-IDE  
Allows for easy  
removal of hard  
drives. Includes key-lock!



**Color Board Cameras  
with Audio Function  
ONLY \$139**  
Part #VM3010-A

We also have great  
deals on bullet (B/W &  
color) cameras,  
pinhole cameras (B/W & color), some  
with audio. Get specs, details &  
prices from our web site.



**Electronic Soldering Station  
with Ceramic Heating Element,  
3-Conductor Grounded Power  
Cord, 250-  
480°C (470-  
900°F) Fast  
Heating  
ONLY \$39**  
Part #SR-976  
Extra tip selection on our web site.



Get all of the specifications and details on these items  
and thousands of other electronic components, test  
equipment, PCB supplies, computer parts, and much  
much more at [www.web-tronics.com](http://www.web-tronics.com)  
Secure on-line ordering, or by FAX, toll free, or snail mail.



**Circuit Specialists, Inc.**  
800-528-1417/(602)464-2485  
FAX (602)464-5824

**!!!BROADCAST EQUIPMENT!!!**  
We manufacture & carry Stereo FM Transmitters,  
RF Amplifiers, Low Pass Filters, Antennas, DJ Mixing  
Boards & Consoles, Mics, Compressor/Limiters, Digital  
Reverbs, Automation Software, RF Test Equipment, RF Parts  
including BGY133's, and much more! Call For Free Catalog.  
**Progressive Concepts**  
Box 586 Streamwood, IL 60107  
(630)736-9822 FAX (630)736-0353

## CABLE TV CONVERTERS

Equipment & Accessories  
Wholesalers Welcome  
Call C&D ELECTRONICS  
1-888-615-5757 M-F 10a-6p

## FCC License Preparation

Electronics Tech., Avionics, Marine & Radar  
HOMESTUDY—Fast, Easy & Inexpensive  
Manuals, Audio, Video, PC disks, latest Q&As  
Free 1-800-800-7555 "Guaranteed Pass"  
See at <http://www.worldaccessnet.com>  
BusinessShowcase/wpt. 4701 NE 47th St.  
Vancouver, WA 98661 - WPT Publications

**SURVEILLANCE HIDDEN CAMERAS**  
DIRECT FROM MANUFACTURER—BEST PRICE IN THE MARKET  
Ultra miniature hidden camera, in dome, smoke or motion  
detector w/ mic. B/W or Color. Wide view angle. Low light  
sensitivity + super sharp images, plus video and audio out-  
put. From \$159.00. Also 1/2" B/W board cameras w/ mic,  
starts at \$79.00 USD. Wireless hidden cameras, start at only  
\$249.00 USD. Plus \$5.95 for S&H. Wholesale Welcome.  
COD, Check, Money Order or Visa/MC.  
**BOLIDE INTERNATIONAL CORPORATION**  
PH: (800) 355-0895 or (626) 575-8178  
9660 Flair Drive #218, El Monte, CA 91731  
<http://www.bolideamazingproducts.com/>

BREAST CANCER BEGINS  
EVEN SMALLER THAN THIS.  
THAT'S WHY YOU  
NEED A YEARLY  
MAMMOGRAM,  
ESPECIALLY AS  
YOU GET OLDER.  
MAMMOGRAMS  
CAN DETECT  
LUMPS TOO  
SMALL FOR  
YOU TO FEEL  
AND EARLY  
DETECTION  
MAY SAVE  
YOUR LIFE,  
SO CALL  
**1-800-  
ACS  
2345.**

GET A MAMMOGRAM.  
EARLY DETECTION IS THE BEST PROTECTION.  
A Division of  
The American Cancer Society

## Zagros Robotics

World Class Engineering and Programming



PO Box 460342  
St. Louis, MO 63146-7342  
(314)768-1328  
[info@zagrosrobotics.com](mailto:info@zagrosrobotics.com)  
[www.zagrosrobotics.com](http://www.zagrosrobotics.com)

## PicC C Compiler \$59

for Microchip's PIC microcontrollers  
Supports PIC16C55x, 16C8x, 16C82x, 16C8x, 16C92x PIC families

## SnXC C Compiler \$59

Supports SencIX 8x18ac and 8x28ac microcontrollers  
Both compilers based on ANSI C standard. Arrays, unions,  
structures, pointers, strings, function calls, if, for, switch, while,  
interrupt vectors, in-line assembler code, 8 & 16 bit variables, etc.  
Outputs Intel Hex format and assembly code. Code optimizer  
included. Excellent development tools!

## DebugIDE Debugger \$79

C source level debugger for PicC and SnXC compilers. Integrated  
Development Environment. Step, Run, Stop, Reset. Variable  
monitoring and modification. Oscillator/cable kit (\$39)  
732-873-1519 fax: 732-873-1582 e: [grichrc@aol.com](mailto:grichrc@aol.com)  
Grich RC Inc.120 Cedar Grove Ln, Ste 340, Somerset NJ USA 08873  
URL: <http://members.aol.com/picccompile>

## THE TRANSDUCER PROJECT BOOK



**1992T**—From TAB Books. A  
unique collection of practical  
transducer devices that you  
can put together simply and  
inexpensively. You can build  
a seismic sensor, a tempera-  
ture survey meter, an open-  
door annunciator, a moisture  
detector, an automatic night  
light, and more. To order—ask for book **1992T**,  
and include your check for **\$6.99 - clearance**  
(includes s&h) in the US and Canada, and  
order from —Electronic Technology Today  
Inc., P.O. Box 240, Massapequa Park, NY  
11762-0240. US funds only; use US bank check  
or International money order. Allow 6-8 weeks  
for delivery.  
MA06

## ELECTRONIC GAMES

**BP69**—A number of interest-  
ing electronic game projects  
using IC's are presented. In-  
cludes 19 different projects  
ranging from a simple coin flip-  
per, to a competitive reaction  
game, to electronic roulette, a  
combination lock game, a  
game timer and more. To  
order BP69 send **\$4.99 clear-  
ance** (includes s&h) in the  
US and Canada to Electronic  
Technology Today Inc., P.O. Box 240, Mass-  
apequa Park, NY 11762-0240. US funds only.  
Use US bank check or International Money  
Order. Allow 6-8 weeks for delivery.  
MA07



Interactive catalog: [www.tekview.com](http://www.tekview.com)

**TV  
cable  
CONVERTERS  
&  
EQUIPMENT**

**Clearview Group**

**(800)739-2253**

\* 30 days money back  
guarantee  
\* 1 yr warranty  
\* Quantity Discounts  
\* Dealers Welcome!

**VISA MC AMEX C.O.D.**



# PROFESSIONAL DESOLDERING with the World's Best Transportable, Totally Self-Contained Desoldering Tool

**Now Get**

## More Vacuum

Mike Murphy - Service Center - Van Nuys CA 818-785-7805

The single best investment of repair equipment we've made. It outperforms all other desoldering tools we've used. Easier to use and least expensive.

Dick Manning - Dicks Electronics - Hartland WI 414-367-8339

The ease & speed of component removal greatly increases productive time. The SMD kit makes SMD removal a breeze, even for inexperienced Techs.

## Quicker Vacuum

Don Scott -

LAV Electronics - Healeah-Miami Lakes FL

I am a constant user of the SC7000 Desoldering Tool and for quick component removal, this unit has no equal. It also comes with excellent company support. I am very satisfied and highly recommend it to anyone in the servicing field.

George Hefner - Hefner Electronics - Coleridge NE 402-283-4333

Being a one-man service center, I hesitated to spend the money on a desoldering tool, however all that changed when I nearly ruined a \$400 computer logic board. It has cut my desoldering time by 50%.

## Higher Temperature

Don

Cressin - Certified Electronics Service - Ellicott City MD 301-461-8008

We have obtained excellent results with the SC7000 including repairing high density U/V tuners. It is one of the best purchases we have made.

Doug Pettit - LuRay Electronics - LuRay VA 703-743-5400

We found that the SC7000 not only saves money vs. wick, but saves valuable time in troubleshooting. It allows you to be more accurate in removing SMD's.

**Sale Price  
\$395.00**

## New Features

- ♦ Totally Self Contained diaphragm vacuum pump and AC motor for high vacuum suction or reversible hot air blow for SMD removal.
- ♦ 100 Watt Ceramic heater with zero-crossover switching heater control circuit which prevents spikes and leakage currents.
- ♦ Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
- ♦ Totally ESD Safe. The housing contains carbon and the tip is at ground potential for complete ESD Protection.

Howard Electronic Instruments, Inc.  
6222 N. Oliver Kechi, KS 67067

**FREE TRIAL**

Available on Request

Price includes  
stand worth \$25.00  
one extra filter, and  
two tip cleaners.

Timothy Kraft - Monikraft, Inc.  
Cherry Hill NJ 609-751-3252

We replaced all our existing desoldering stations with the SC7000. Our technicians are very pleased with the improved performance, portability, and reliability over our previous higher priced equipment.

Bill Warren CET/CSM -  
Warrens Audio & Video -  
Knoxville TN - 234-546-1128

We have been extremely satisfied with the quality and durability of the DEN-ON SC7000 as well as with after the sale support.

Keith Sahs - J & M Electronics  
Omaha NE 402-291-7100

It's a must tool for my bench. I can desolder multiple pin IC's quickly and clean. It will even take up large solder amounts on tuner and case grounds.

**For More Info  
and 5% Savings Go To**

<http://www.heinc.com/sc7000zb.html>

## New Specifications

- ♦ Voltage — AC 100v, 120V, 230V, 50/60 HZ
- ♦ Power Consumption — 120W
- ♦ Pump — Diaphragm Type
- ♦ Motor Output — 12W
- ♦ Vacuum Attained — 650mm Hg
- ♦ Temperature Range — 300° C — 500° C (572° F — 932° F)
- ♦ Air Flow Rate — 15 Liter/Minute (Open)
- ♦ Heater — 100W (Ceramic)
- ♦ Control System — Feed Back Zero Cross-over Type
- ♦ Net Weight — 420 Grams

Visa - M/C - Discover - American Express - Terms to Qualifying Companies  
30 Day Money Back Total Satisfaction Guarantee - One Year Parts and Labor Warranty

**HOWARD**  
**HEI** ELECTRONIC  
INSTRUMENTS INC  
Your Desoldering Specialists

Toll Free U.S. and Canada

**1-800-394-1984**

Web Site [www.heinc.com](http://www.heinc.com)  
E-Mail [sales@heinc.com](mailto:sales@heinc.com)  
International (316) 744-1993  
or Fax (316) 744-1994

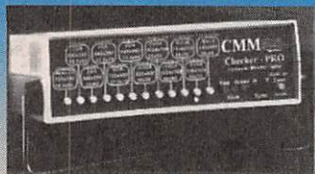
CIRCLE 331 ON FREE INFORMATION CARD



# CMM

Monitor/TV Test Equipment

## Checker Pro



There is the Computer monitor tester you have been asking for. Sweep rates to 15-64 kHz, MGA, CGA, VGA, lots of MACs, even video (mono), GRAY SCALE, quick push button operation, "Energy Star" testing, and more. AC or Battery.

**PRICE: \$499.95**

## Checker 12e



Now you can repair and test Computer monitors with ease. With sweep rates up to 64KHz., eight step gray scale, white screen, single color mode. Mac II, EGA, CGA support, you can run almost ANY PC monitor. And it is EASY to use. Color front panel displays show just what you should see. Don't let its' small size fool you. It is the most powerful handheld available, and it supports ALL basic VGA modes (some don't). It is suitable for bench or field operations. Battery or AC operation.

**PRICE: \$295**

## Checker TV Pro & TV Jr.



The TV Pro is just the tool for your repair bench. It provides Video, S-Video, and RF outputs. It also has the most important pattern, GRAY SCALE! You can't set up a color TV without it. All with NTSC standards and COMPLEX sync. The RF output also includes an audio tone and STEREO signaling. With colorbars, gray scale, crosshatch with dots, you can set and test quickly.

**Checker TV Pro...PRICE: \$499.95**

The TV Jr. is a small NTSC video generator with colorbars crosshatch with dots, white, red, blue, green, and black screens. Small enough to fit in your pocket, powerful enough to drive the largest projection TV!

**Checker TV Jr....PRICE: \$129.00**

**Computer & Monitor**

**Maintenance, Inc.**

1-800-466-4411 • 770-662-5633

<http://www.computermonitor.com>

# POPTRONIX®

Online Edition

We're on the web

## FREE

We are starting up,  
but you can watch us grow!

Projects for beginners  
to experts!  
New Product information!  
Bookstore—discover  
what's new!

<http://www.popttronix.com>

WE'RE WITH YOU EVERY DAY  
24 HOURS A DAY! DROP IN!  
WE'D LOVE TO HAVE YOU VISIT!

### Coil Design and Construction Manual



## YOU CAN WIND YOUR OWN COILS?

There's no trick to it except knowing what you are doing. In a unique, 106-page book you can become expert in winding RF, IF, audio and power coils, chokes and transformers. Practically every type of coil is discussed and necessary calculations are given with the mathematical data simplified for use by anyone. Get your copy today!

Mail coupon to:

**Electronics Technology Today, Inc.**  
P.O. Box 240

Massapequa Park, NY 11762-0240

Please send me my copy of *Coil Design and Construction Manual* (BP160). I enclose a check or money order for \$8.99 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

ZIP \_\_\_\_\_

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

## Locate Bad Caps Fast

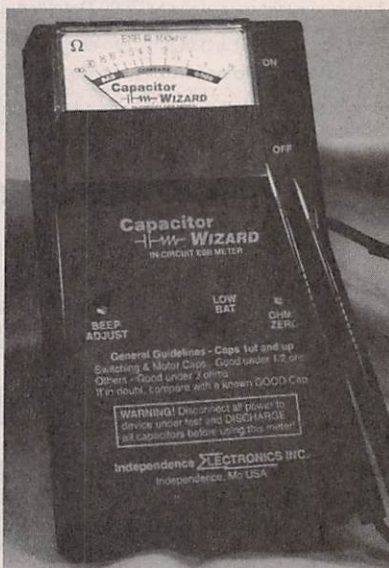
### IN-CIRCUIT!!

Lower Costly Service Time  
Reduce Costly Callbacks  
Tame "TOUGH DOGS" in Minutes  
**INSIST on the ORIGINAL**  
**Capacitor™**

**WIZARD**

IN-CIRCUIT ESR METER

Large, easy to read analog meter makes for the fastest, most accurate testing available! Unique "Cap GOOD" beeper makes testing caps in circuit **virtually INSTANTANEOUS!!** Needle sharp **GOLD PLATED** stainless steel probes provide FAST and POSITIVE connection to both AXIAL and RADIAL caps.



Technicians say the Capacitor Wizard is "the most cost effective instrument on their workbench!"

**ONLY \$179.95**  
**800-394-1984**

For More Information goto  
[www.heinc.com/ieinc/cwinfo.htm](http://www.heinc.com/ieinc/cwinfo.htm)

**30 DAY MONEY BACK GUARANTEE**  
**Order today! You Can't Lose!!!**

Made in the USA!



**Howard Electronic Instruments, Inc.**

6222 N. Oliver, Kechi, KS 67067

316-744-1993 International

316-744-1994 Fax

Email: [sales@heinc.com](mailto:sales@heinc.com)





NEW!  
μLINK™ SERIES

Send us a (6x9) SASE for your FREE catalog.

### μLink™ Infrared Remote Control System

- 4 Channel IR Keychain Transmitter (pcb 1.1"x 1.2") IRTX4-A
  - 4 Channel IR Receiver (pcb 1.1"x 1.9") IRRX4-A
  - Each receiver can LEARN up to 4 transmitters.
  - Each transmitter can have a different access level.
  - User selectable receiver output modes.
  - Security, Industrial and Home Control Applications
  - Up to 9m Range.
  - RX and TX IC's available. Custom design service available.
- Only \$39.<sup>95</sup>/pair + S&H, additional IRTX4-A units \$19.<sup>95</sup>

### SURFACE MOUNT KITS:

- Pager Decoder Interface
- Garage Door Openers

- PLL XTAL FM MIC
- LC tuned FM MIC
- Phone transmitters

Orders: 1-800-417-6689 Mon-Fri 9AM-6PM ET  
visa/mastercard/money orders  
email: [iecorp@i-e-c.com](mailto:iecorp@i-e-c.com)  
web: [www.irmicrolink.com](http://www.irmicrolink.com)  
IEC ♦ PO Box 52347 ♦ Knoxville TN 37950

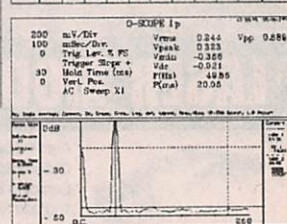
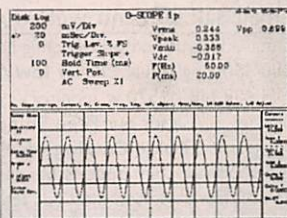
COPYRIGHT ©1998 International Electronics Corp.

## DIGITAL STORAGE OSCILLOSCOPES

WITH  
SPECTRUM  
ANALYZER,  
DVM, FREQ.  
COUNTER,  
AND DATA  
LOGGER.

from  
**\$189.**

PORTABLE  
MODULES  
CONVERT PC'S  
INTO  
MULTIPURPOSE  
TEST AND  
MEASURING  
INSTRUMENTS.



Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

### FEATURES:

- ♦ PORTABLE UNITS TO 25 MHz
- ♦ USES PRINTER PORT
- ♦ USES STD. PROBES

### OPTIONS:

- ♦ PROBE SETS
- ♦ AUTOMOTIVE PROBES
- ♦ BATTERY PACKS
- ♦ SOFT & HARD CASES

O-Scopes Made in U.S.A.

Picos Made in U.K.

Same Day Shipping  
Includes Cable, Software & Manuals

O-Scope I (DC-50KHz, single trace) .....\$189.  
O-Scope II (DC-500KHz, dual trace) .....\$349.  
PICO (ADC 200/20) (DC-10MHz, dual trace) .....CALL  
PICO (ADC 200/50) (DC-25MHz, dual trace) .....CALL  
PICO pc based data loggers from \$99.

Shipping within U.S. UPS Ground \$7.50 (Second day \$11.50)

SEND CREDIT CARD INFO., M.O., or CHECK, OR CALL

**1-800-980-9806**

Allison Technology Corporation

2006 FINNEY-VALLET, ROSENBERG, TX 77471

PHONE: 281-239-8500 FAX: 281-239-8006

<http://www.atcweb.com>

## CONTROL MEASURE INPUT

RELAYS • LIGHTS • MOTORS  
TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY  
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

**MODEL 30 ..... \$79**

- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC

**MODEL 45 ..... \$189**

- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

**MODEL 100 ..... \$279**

- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

**MODEL 150-02 .... \$179**

- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

**MODEL 40 ..... \$109**

- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

**MODEL 70 ..... \$239**

- RS-232 INTERFACE
- 18 BIT A/D
- 6.5 DIGIT
- UP TO 60 SMP/SEC

## Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754  
920 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53576



## 1 MB cache, AMD 300

3DNow System featuring: 11/1/98

Enlight Mini Tower, VIA chipset, 100 MHz operation, 2 USB ports, 64 MB PC-100 compatible memory, 7.5 GB 7200 rpm Ultra DMA33 hard drive, 32X CD-Rom with audio button, 4 MB AGP video card, S3 Trio 3D, 1.44 floppy, V.90/X2 PCI faxmodem, 3D sound card full-size speaker set, 15" digital monitor.

Windows 98 on CD ..... **\$997**

## tech-specialties, Inc.

(800)864-5391, fax: (713)307-0314

email: sales@ts.nu, web: www.ts.nu

Detailed Quote on other configurations (PII 300/450, single/dual CPU or low cost, 233 MHz, 32 MB - \$570 w. monitor) by email, fax or phone. Ask for our Free Shipping option! Illustrated 32-page Catalog with latest parts, many more system options, benchmark comparisons and technical tips free!

## LASER MODULE



Auto Power Control  
Collimated Laser  
Compact Size  
100,000 hr lifetime  
No Electronics Required

Visible Laser Modules (635-670 nm)  
TTL Modulated Laser Modules  
Line Generator Laser Modules  
Infrared Laser Modules (780-830 nm)

from  
**\$29 (US)**

## LASER POINTER



Focus Adjustable  
Elegant Design  
Solid Metal Body

Pen Style Laser Pointer (1500 ft visibility)  
Key Chain Laser Pointer (1500 ft visibility)  
Available in silver and black finish.

**\$19.95 (US)**

World Star Tech.

Tel: (416) 204 6298 Fax: (416) 596 7619

http://www.worldstartech.com e-mail: info@worldstartech.com

Ask for free catalog

www.jm-micro.com

## PIC In-Circuit Emulator

for the PIC16Cxx from \$295

**PIC Programmer \$155**

**80C552 (8051) Development**

Training System **\$235**

**68HC11 SBC \$120**

**ROMY-16 EPROM Emulator**

from \$195

**Universal Microprocessor  
Simulator/Debugger (including  
Assembler, and Disassembler)**

**\$100 each CPU**

**J&M Microtek, Inc.**

83 Seaman Rd, W Orange, NJ 07052

Tel: (973) 325-1892 Fax: (973) 736-4567

## PIC PROJECTS Book & CD-ROM

Many PIC Projects for Beginners & Experts!  
Includes Software, Documentation, and PCB Layout

- LCDs
- X10 - Home Automation
- Keypads
- Serial Port Interface
- On-Screen Displays
- Robotics
- Data Logging
- Serial-Parallel
- And Many More!

Book &  
CD Only  
**\$24.95**

## PIC Programmer

Programs all PIC16C55x/6x/7x/8x/9x,  
PIC 16F8x, and PIC12C devices.  
Optional ZIF adapters for SOIC & PLCC.  
Includes all necessary software.  
Only \$39.95

Buy  
Both for  
**\$59.95**

We accept VISA • MasterCard • American Express

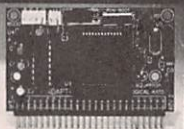
To order, call Worldwyde @ 1-800-773-6698

21365 Randall Street • Farmington Hills, MI 48336

Visit us on the web at [www.worldwyde.com/pic](http://www.worldwyde.com/pic)

## ADAPT-11 68HC11 Modules for Solderless Breadboards

- miniature 2.0" by 2.8" module
- plugs vertically into solderless breadboard for easy development
- BOOT/RUN switch for easy programming via PC serial port
- all I/O lines on dual row connector



Complete modular prototyping system!  
Expansion accessories available!

For just US\$74.95, our Starter Package (AD11SP) provides everything you need to get going fast! Now you can harness the power of the popular 68HC11 in your projects! Includes ADAPT-11 with 68HC11E2, providing 2K EPROM (re-programmable), 8 channel 8-bit Analog-to-Digital Converter (ADC), hardware timers, counters, interrupts, Serial Peripheral Interface (SPI), Serial Communications Interface (SCI), & more! On-board RS-232 interface (cable included), 5-volt regulator, 8MHz crystal, reset circuit, and convenient program/run switch. Comes with non-commercial versions of 'HC11 Assembler, BASIC, & C, as well as handy utilities & example code. Includes Motorola 68HC11 Pocket Programming Reference Guide and manual with schematic. All you need is a PC to write & program your software, a DC power supply, and a solderless breadboard (or protoboard) to build your application circuits on (or use our modular accessories).

VISA • MasterCard • American Express • Discover

**TECHNOLOGICAL ARTS**

309 Aragona Blvd., Suite 102, Box 418, Va. Beach, VA 23462

1644 Bayview Avenue, Box 1704, Toronto, ON M4G 3C2

voice/fax: (416) 963-8996 [www.interlog.com/~techart](http://www.interlog.com/~techart)

## SCIENCE FAIR ELECTRONICS

One of the largest electronic kit selection

Address: 9740 CAMPO RD. #209

SPRING VALLEY, CA 91977

PHONE: (619) 668-0107

TOLL FREE 1-800-475-0349

FAX: (619) 461-6961

We Carry Electronic Kits, Robots,  
Motors, Tools, Test Equipment,  
batteries, etc.

To receive a **FREE CATALOG** fax or  
mail your address with phone number  
to the address above and you will  
automatically become a member with  
no extra charge.

## PIC Microcontroller Programmer Kit

Super Value! • Program all 8, 18, 28 & 40 pin PICs in the 12C5xx, 14000 and 16Cxx series (except 16C54-58). • All components, PCB and Instructions included. • Parallel port of PC is used with straight through (25 pin) cable (not supplied). • This kit uses the P16PRO shareware which is downloaded from the web and registered for \$25. • Visit [www.electronics123.com](http://www.electronics123.com) for the complete list of PICs that can be programmed and for more information. • Can program 64 pin PICs with adapter (not supplied).

**\$14.95**  
+S&H \$4.95\*

## Running Lights Kit

Ideal for parties, discos, shop windows and X-mas decorations. 8 LEDs switch on and off in 10 push button selectable patterns. 8 different speed levels for a total of 80 combinations! Includes PCB, components & instructions. Uses a 51 microcontroller. Can operate light bulbs by using TRIACs. (8xTRIACs is \$6 extra) \*S&H to Canada is \$7.95

**\$14.95**  
+S&H \$4.95\*

Orders only: 1-888-549-3749 (USA & Canada)

Info: (330) 549-3726 Request a FREE catalog or visit us at: [www.electronics123.com](http://www.electronics123.com) for more products.

Amazon Electronics, Box 21 Columbiana OH 44408

## The Hack & Crack Bible on CD-ROM

Includes all Software, Documentation,  
Plans, and PCB Layouts!

Unlock the secrets of:

- DSS & Smart Cards
- Programming & Schematics
- Cable Test Devices
- Sony Playstation
- Mod Chip/CD Backups/Emulation
- Backup Sega & SNES Console Cartridges
- Sega & SNES Emulation on your PC or Mac
- Warex - where to find them on the Internet
- And Much More!

Only  
**\$24.95**

PC & Mac Compatible CD-ROM

We accept VISA • MasterCard • American Express

To order, call Worldwyde @ 1-800-773-6698

21365 Randall Street • Farmington Hills, MI 48336

Visit us on the web at [www.worldwyde.com/hack](http://www.worldwyde.com/hack)

## Timid about getting on the... World Wide Web?

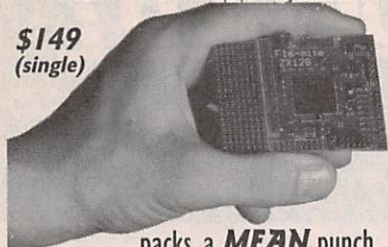
You've heard about the *Information Superhighway* and all the hype that goes with it! Sort of makes you feel timid about getting on the Web. Put your fears aside! A new book, *The Internet and World Wide Web Explained*, eliminates all the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will believe you are an Internet guru!

To order Book #BP403 send \$7.99 plus \$3.00 for shipping in the U.S. and Canada only to Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.



## FRIENDLY LITTLE MICRO CONTROLLER

**\$149**  
(single)



...packs a **MEAN** punch  
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •

\* Intec Automation Inc. v: 250-721-5150  
www.steroidmicros.com fx: 250-721-4191

**Direct from Manufacturer**  
We will beat any competitor's price

## World's Smallest Wireless Video Camera!

- Transmits video up to 1000 ft.
- Runs on 9V battery for 12 hrs.
- Can be built into just about anything (beeper, clock, etc.)

We also carry:

- Color micro video cameras
- B&W micro video cameras
- Hidden cameras
- Custom video systems
- Countersurveillance & More

World's smallest  
plug & play system  
about 1" x 1"

Looking  
for  
Distributors

Call for a free catalog (305) 667-4545  
**SECURETEK** Fax (305) 667-1744  
7175 SW 47 St. #205 • Miami, FL 33155

## Printed Circuits in Minutes Direct From LaserPrint!

8 1/2" x 11"  
\* Or Photocopy  
\*\* Use standard  
household iron  
or P-n-P Press.

1. LaserPrint\*
2. Press On\*\*
3. Peel Off
4. Etch



Use Standard Copper Clad Board  
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100  
Visa/MC/PO/Ck/MO \$4 S&H

Techniks Inc.  
P.O. Box 463  
Ringoes NJ 08551  
ph. 908.788.8249 fax 908.788.8837  
http://chelsea.ios.com/~techniks  
Retail Dealer Inquiries Invited



**fake KEYBOARD! fake MOUSE!**

With the **KBM-AT** a PC-AT or PS/2 can be used with a keyboard-monitor-mouse manual switch box and still boot perfectly; NO "keyboard error" message! No "mouse not installed" message! Hot-connect a keyboard to the KBM-AT anytime! Works great with PC's in remote applications too.

PRICE \$34.80 each  
SPECIAL 2 (or more) **\$28.80** each

**CYLAB**  
incorporated

513 271 4436 fax 271 3933  
5725 Dragon Way  
Cincinnati, Ohio 45227

## 10 Hr. Telephone Recorder \$69

+\$6.95 S/H



Automatically starts recording when the phone is picked up and stops when you hang up. Records both sides of the conversation!  
Telephone recording controller only \$15  
3 Hour Micro Telephone recorder with tape \$49

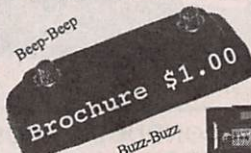
**FREE CATALOG**  
**www.mscelectronics.com**

**MSC Electronics**  
PO BOX 461 Jessup, MD 20794  
(301) 497-1600  
FAX (301) 497-1925



## Notch Filters

Test Chips



Filter Kits  
1 to 2 \$20 each  
3 to 9 \$15 each  
10 to 20 \$9 each  
21 or more \$7 each

**Adult Wholesale  
Video's**

\$ 379.00  
Free Shipping

Video Media  
P.O. Box 93/6025  
Margate, FL 33093-6025  
(954)-752-9202



www.nutnet.com

**Weeder  
Technologies**



Visit our  
**ON-LINE  
CATALOG**



**Pro-Kit**

PO Box 2426, Ft. Walton Beach, FL 32549

www.weedtech.com

Voice/Fax 850-863-5723

### Stackable RS-232 Kits

**Digital I/O** - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 192 I/O points. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. **\$32**

**Analog Input** - 8 Input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **\$49**

**Home Automation (X-10)** - Connects between a TW523 and your serial port. Receive and transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. **\$39**

**Caller ID** - Decodes the caller ID data and sends it to your serial port in a pre-formatted ASCII character string. Example: \*12/31 08:45 850-863-5723 Weeder, Terry <CR>. Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **\$35**

**Touch-Tone Input** - Decodes DTMF tones used to dial telephones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation or Digital I/O kits using a remote telephone. **\$34**

### Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have "not" been entered.

Block out selected outgoing calls. Bypass at any time using your password. **\$35**

Block out selected incoming calls. Calls identified using Caller ID data. **\$46**

### Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands. Monitor room noises with built in mic. "Dial-Out" pin instructs unit to pick up phone and dial user entered number(s). Password protected. **\$49**

### IR Remote Control Receiver

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32**

### DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **\$55**



# ARE YOU BEING "BUGGED?"

## OUR FINEST

# Counter-Surveillance Device



## THE ULTIMATE IN "BUG" DETECTION EQUIPMENT "DEBUGS" ROOMS AND TELEPHONES!

If you require GUARANTEED PROTECTION against electronic telephone monitoring devices and COMPLETE CONFIDENTIAL PRIVACY in certain rooms and areas, we highly recommend the COUNTER-SURVEILLANCE DETECTOR CSD-18.

EVEN AS YOU READ THIS, countless individuals and firms are being enormously damaged by having their private conversations overheard, monitored, and/or recorded. Almost without exception and AFTER the fact, the victims make a statement something along the lines of "But, I never thought it could happen to ME!"

### CONDUCT A PROFESSIONAL SEARCH...ANYTIME...ANYWHERE!



Every newspaper and magazine article and every radio and TV story discussing some new episode involving "Bugging" devices, continues to increase the ever growing demand for electronic Counter-Surveillance "sweeps" and equipment. The very limited supply of competently trained and equipped Counter-Surveillance specialists has created a situation where "sweep" rates exceeding \$250 per hour are now considered reasonable and appropriate.

This is an exciting, immensely interesting and profitable field that you can enter with a minimum investment. Two hours actual practice with the CSD-18 will have you "reading" and "clearing" telephones and rooms with professional ease and competence. The average fee for "debugging" a single telephone is over \$200.00. It requires about 45 minutes to complete the job and once it gets around that YOU can provide this service, you'll quickly have more clients than you can handle. Even if you choose to provide "sweeps" for only a small number of friends and associates, your initial investment will quickly be returned many times over.

### FREE WITH ORDER!

#### SUBMINIATURE "BODY WIRE" DETECTOR!

If you fear the possibility of being overheard and/or recorded during private conversations and require "silent" notification, we've also included our SBD-5 (regularly \$225) as a FREE GIFT! Only 3" x 2" x 1", this exciting new development in micro-miniaturization will instantly detect hidden body wires at ranges up to 10 ft and alert you via a silent vibration.

#### BIG MONEY OPPORTUNITIES!

Also, complete information describing the fantastic opportunities now open to trained Counter-Surveillance technicians and how a number of individuals are reaping a Bonanza in this booming business! You'll learn exactly how the ever increasing use of Electronic Listening Devices by investigative agencies, government agencies, jealous suitors and unscrupulous business competitors, etc. has created huge demand for this service.

#### FASCINATING HI-TECH INFORMATION PACKAGE!

A detailed analysis of a variety of extremely fascinating hi-tech devices and procedures used for ultra-sophisticated audio and video eavesdropping including micro-wave and laser device monitoring; new methods for listening thru walls; all about scramblers, voice changers and exactly how neighbors eavesdrop. How missing persons are found, confidential data banks are broken into, lie detectors deceived and much more!

A comprehensive information package JAM-PACKED FULL of some of the most exciting and fascinating reading imaginable. Reads like a James Bond novel, with one important exception...IT'S NOT FICTION!

### EXTREME SENSITIVITY!

This is our finest piece of detection equipment! The CSD-18 quickly locates electronic eavesdropping devices in telephones, homes, offices, vehicles, boats, or concealed on the body. It will actually pick up many eavesdropping transmitters at ranges up to 25 ft! Extreme sensitivity is obtained via ultra-efficient amplification circuitry directly following the RF detection stages. Excellent quality dynamic headphones exclude all external sounds to further enhance detector output.

Encompassing an extremely wide-band frequency coverage of under 1 Mhz to over 3 Ghz, the CSD-18 quickly "homes-in" on any eavesdropping transmitter and immediately pinpoints its location. The closer you get to the "bug", the further the needle moves to the right. It's as simple as that.



FULL RANGE DYNAMIC HEADPHONES

### "FLASHING" LED WARNS YOU INSTANTLY!



And, for maximum telephone security, the CSD-18 automatically analyzes a pre-programmed series of electronic measurements along the telephone line and converts the analysis into an easy to follow, step by step, test procedure. No technical knowledge is required or necessary. A visual indication (via a flashing LED) immediately reveals the presence of the various types of telephone "taps" and the flashing sequence identifies the actual type of eavesdropping device.

### DETECTS THE LATEST "SUPER-BUGS"

Exclusive GSS proprietary circuitry assures the utmost privacy protection possible today. The CSD-18 detects even the very latest ultra-sophisticated eavesdropping devices specifically designed to defeat detection, including sophisticated "Frequency Hoppers" and "Burst Bugs". Also includes multi-line option for testing business phones.

### THE ONE "BUG" TO FEAR MOST!

While most individuals are now somewhat guarded in their telephone conversations, they still rather naively feel secure in the "privacy" of their own home or office. However, the most common type of "tap" presently used by eavesdroppers now picks up ALL SOUNDS AND CONVERSATION WITHIN A ROOM... WITH THE TELEPHONE STILL ON THE HOOK!

Due to this devastating capability, this "Infinity" tap (variously referred to as Infinity Transmitter, Hookswitch Bypass, 3rd Wire, Harmonica Bug, etc.) has become the "bug of choice".

In flagrant violation of federal law prohibiting their use and sale, these devices in various forms are openly advertised in many technical publications for as little as \$30. Literally thousands of these devices are now in the hands of unscrupulous individuals all over the country!

In response to this ever-growing threat, a uniquely engineered feature of the CSD-18 now also detects Infinity type devices anywhere "down the line".

In other words, if ANYONE... ANYWHERE... is utilizing the telephone tip and/or ring wires to monitor your private room conversations while your telephone is on the hook, you'll immediately be made aware of it via a flashing LED!

### 100% POSITIVE INDICATION

The CSD-18 also flawlessly detects "Series" and "Parallel" telephone transmitters and "Telephone Recording Devices". And, a separate feature silently indicates when extension phones are picked up or being used. The CSD-18 completely eliminates all doubt and guesswork.

### EXCLUSIVE "LISTEN-IN" FEATURE!

The CSD-18 will even allow you to "listen-in" to exactly what the eavesdropper is surreptitiously monitoring. And, without the eavesdropper ever becoming aware that he has been detected! We are unaware of ANY other detection equipment having this combined capability AT ANY PRICE!

### MAXIMUM PROTECTION

The CSD-18 detects and locates ALL major categories of surveillance equipment including:

**BUMPER BEEPERS,  
"BODY" TRANSMITTERS  
TELEPHONE RECORDING DEVICES  
SERIES & PARALLEL PHONE TRANSMITTERS  
"INFINITY", MICRO-WAVE AND "LASER" BUGS  
& ALL TYPES OF CONCEALED TRANSMITTERS**  
including Video, Computer and Fax Transmitters

CSD-18 **\$495** Complete

Includes headphones, antenna/probe, all plugs and adapters, batteries, the Free SBD-5 & Info Packages.

### HOW TO ORDER

Order NOW by Mail or Telephone. 10 DAY MONEY BACK GUARANTEE if you're not 100% pleased and completely satisfied. We pay shipping charges on all prepaid & credit card orders. Add \$15 for CODs.

Great Southern Security  
513 Bankhead Highway  
Carrollton, GA 30117

**FOR FASTEST SERVICE CALL TOLL FREE**

ORDER BY PHONE



**1 800 732-5000**

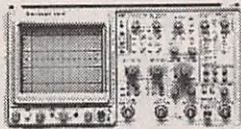




# THE QUALITY YOU DESERVE

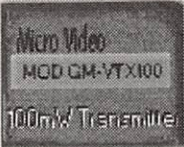
## TEK 2465A/DM, 350 MHz, 4Chan. O'scope with DMM

Super 350 MHz four-channel scope. Sens: 2 mV at 350MHz. Risettime 1ns. Sweep: 500ps/Div. Voltage & Time cursors, screen readout. 1 Mohm / 50-ohm input. Digitize, store and recall waveforms. Auto Setup, Sequencing & more. Accessories: 10X Probes (2), Pouch, Ops Manual, Cover. Opt.01 = Digital Multimeter. Option 09 = Counter/Timer/Trigger and Word Recognizer. Mint. **TEKTRONIX 2465A/DM..... \$2695**



## WORLD'S SMALLEST, 100mW, VIDEO TRANSMITTER,

Only 0.98" x 0.8" x 0.037" in size. Transmits crystal controlled, hi-res., color or B&W images with 100mW output! The transmitter you've been waiting for. **Shown actual size.** Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. UHF Bow tie antenna with balun and 3' F cable for TV supplied. Perfect with GM1000A camera. Both will fit in a cigarette pack...with the battery! The best anywhere.



**TVX-100.....\$189 with GM1000A-PH CAM.....\$268**

## SUPER! UNDERWATER (to 60 ft.) "INSPECTION" CAMERA with INTERNAL INFRARED ILLUMINATOR!

Sleek black anodized, BRASS, housing is O-Ring sealed & **WATERPROOF**. Adjustable mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 3.6mm, 92° FOV glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25" d. X 2" long. With 60 ft. cable. Great for gen'l outdoor use also. **GM-300K...\$199**



## TWO MINI C-MOUNT CAMERAS, Super sensitive, GM410 or the general purpose GM412, The GM-412 specs: B&W, size 1.5" sq. X 2.4"L, 250,000 Pixels, 380 Lines Resolution, Sensitivity 0.3 Lux, The GM410 specs:

size only 1.5" SQ. x 1.6"L, >270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX, Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, BNC video out, Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform ANY camera in this magazine. Multi-lens options are available. **GM412, less lens...\$119, GM410, less lens...\$169**

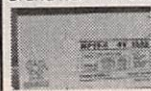


## C-MOUNT LENS OPTIONS to ENHANCE YOUR IMAGE: Fast Lenses for Low Light or General Purpose Normal Light

16mm, f1.6, 15° FOV .....\$39	4mm, 80° FOV .....\$24
8mm, f1.3, 40° FOV .....\$49	8mm, 40° FOV .....\$24
4mm, f1.4, 78° FOV .....\$49	12mm, 28° FOV .....\$24

## 6V @ 12 AH SEALED, RECHARGEABLE, LEAD ACID BATTERY

Brand new Panasonic type LCR6V12P1, tough to get at a discount. Very compact. Use two for a 12V @ 12AH pack. Two top mounted 1/4" faston connectors. Perfect for robotics and other high drain applications. Size: 5.9" x 3.7" H x 1.97" D. **REG. \$18ea. NOW 2 for \$20, or 10/\$89**



**10V @ 2.5 AH SEALED, LEAD ACID, PACK** Each pack consists of five, 2 Volt cells. Each cell the size of a std. 'D' battery. Arranged as 1X5 cells. Enclosed in an ABS outer shell (removed for photo) Mint condition. Perfect for high drain and robotics applications. Make custom packs of any rating. Size: 7.5" x 2.8" H x 1.5" D **5-five packs ....\$20, 30 for \$99**



## YOU CAN NEVER BE TOO THIN or TOO POWERFUL.

Unique, 0.3" thick, Thinline Energy Cell, Portable Energy Products model PLA02V50. Super thin, high performance, patented technology. **RECHARGEABLE** sealed lead acid battery. Each cell is 2V@5AH. Size: 3.1" x 5.3" x 0.3"! Mount in any orientation. Line the bottom of a briefcase or covertly wear on the body. 30% higher density than std. lead acid batteries. **SPECIAL 6 cells \$15 or 24 for \$49**



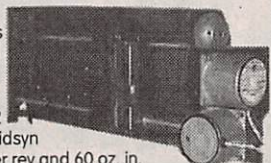
## 4 HEAD TIME LAPSE VCR, Records 24 + HOURS!

Used, refurbished, late model VICON model 424's at only 2/3 off the regular price. On screen programming, time/date stamp, audio, index search, power loss recovery and alarm inputs. Excellent, with manual. **VICON 424.....\$489ea.**



## MOTORIZED LINEAR SLIDE, with Z AXIS DRIVE

Heavy duty 3/8" diameter chromed steel rods provide up to 9 inches of linear travel. X drive is via a toothed belt powered by a SLO-SYN M061-LF-409, 1.25V@3.8A stepper motor with 200 steps per rev and 75 oz. in. hold. The Z axis is attached directly to the slide, provides 2 inches of travel and is powered by its own Rapidsyn 23E-6108BH 1.25V@3.8A stepper. 200 steps per rev and 60 oz. in. of hold. Very precise motion is possible due to the approx. 4:1 ratio toothed belt drive. Nice quality, suitable for gen'l use. Not recommended for ultra precise or high load applications. Removed from precision optical equipment. Overall size: 17"L x 6"H x 5.5"D. Complete assembly mounted on a rigid 1/4" thick base. Ltd. Qty. **"X and Z" DRIVE SYSTEM (as shown).....\$99.**



## ASTRO-CAM, TE COOLED CCD CAMERA HEAD!

Model TE3N/A with KODAK KAF 0400-C1 CCD. These cameras were over bought by a large analytical instrument company. They are in like new condition. We have no data except for the KODAK 768 x 512 CCD specs. Wavelength sensitivity is from 400 to 1080nm. Less than 1.5% non linearity. Fan cooled Peltier device. Bayonet lens mount for 35mm objective. (lens not included) These heads are used in the Capella and Antares systems. With readout rates of 500kHz to 8 MHz, 12-14bit dynamic range, No image retention lag or distortion, high tolerance to over exposure. Size: 4" sq. x 6" Long. Ltd Qty. **Special...\$349ea.**



## Please fax us your list of unique surplus material.

### CLOCK RADIO COVERT CAMERA, New, Magnavox clock radio with

covert low light video camera. Specs. per GM1000A shown below. Connect to anything with a "video in" jack. via RCA style output. Also available wireless model, CRC-2W transmits to cable ready TV or VCR on cable channel 59, up to 500ft. No separate receiver req'd.

**CRC-1std...\$129ea or CRC-2W, Wireless...\$279ea.**



### SEE in TOTAL DARKNESS!

**WEATHERPROOF IR FLOOD**, 48 powerful LED's project a 40 deg. FOV beam up to 45 feet. Automatic on at dusk off at dawn! 110VAC power. Rugged anodized aluminum, housing with adjustable mtg. bracket Size: 4"x5"x6.3"L Commercially made. Brand New! **WPIR...\$179ea.**



### SPECIAL! ULTRA MINI and WEATHERPROOF!



Our "LIPSTICK" camera sets new standards. Sleek black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 12VDC @100mA, 3.7mm, 90° FOV lens. A real glass lens. NTSC video out. 1/2 once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. With 36" leads. **GM-200KSTD...\$99, AC pwr...\$495**

### PINHOLE LENS, "BULLET CAM"

So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250K PIXELS, 90° FOV Pinhole lens. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. **GM-200KPH...\$99**

# RESOURCES UN-LTD.

300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL [unltd4u@tiac.net](mailto:unltd4u@tiac.net)





# Robotics for the Next Millennium.

Exploring the New World of Science Kits.

**OWI's "Next Generation"** of affordable, rugged Robot Kits for the next millennium challenges the enthusiast to solder circuit boards and/or mechanically assemble.

Each OWIKIT also incorporates the basic principles of robotic experiments, sensing and locomotion, guaranteeing an exciting, hands-on adventure of knowledge and fun!

But remember! OWI is the recognized founder and leader in Educational Robot Kits. **ACCEPT NO IMITATIONS.**

Visit our homepage at [www.owirobot.com](http://www.owirobot.com)

WAO-G	OWI-968K	Fuzzy Logic	68 Pg. Book	89.95
ROBOTIC ARM TRAINER	OWI-007	5 Axis Control	53 Pg. Book	69.95
TRIPLE ACTION SOLAR CAR	OWI-685	Solar Sensor	27 Pg. Book	39.95
S-CARGO	OWI-936K	Sound Sensor	47 Pg. Book	36.95
WAO II	OWI-961K	Programmable - Graphic	59 Pg. Book	69.95
SPIDER	OWI-962K	Infrared Sensor	49 Pg. Book	49.95
LINE TRACKER	OWI-963K	Infrared Sensor	48 Pg. Book	49.95
HYPER PEPPY	OWI-969K	Sound / Touch Sensor	46 Pg. Book	24.95
MOON WALKER	OWI-989K	Solar Sensor	10 Pg. Book	34.95

**WAO II**

**TRIPLE ACTION SOLAR CAR**

**ROBOTIC ARM TRAINER**

**HYPER PEPPY**

**SPIDER**

**LINE TRACKER**

**S-CARGO**

**MOON WALKER**

**NEW WAO-G**  
Fuzzy Logic Robot - Draw straight lines, circles and words; learn fuzzy control principles.

**EK ELEKIT**

Be on the lookout for the new exciting

- Amphibious Solar Vehicle
- Remote Controlled Cyclone
- Infrared Sumo Robot

17141 Kingsview Ave., Carson, CA 90749  
Phone: (310) 515-6800  
Fax: (310) 515-1606  
Toll Free: (877) 4-ELEKIT (333548)  
E-mail: [owi@ix.netcom.com](mailto:owi@ix.netcom.com)  
Web Page: [www.owirobot.com](http://www.owirobot.com)

MasterCard VISA

Order M - F: 8a.m. - 4p.m. PST

EDUCATORS \* HOBBYISTS \* ENGINEERS

CIRCLE 334 ON FREE INFORMATION CARD

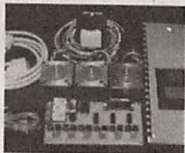
## 3 Axis Motion Control System Complete, ready to run \$ 255.50 + 12.00 S/H

Build or adapt CNC mills, CNC routers, Robots, Etc. Includes: 3 Stepping motors (70 oz/in 200 steps/rev). External board (connects to parallel port of a PC). Power supply. Cables, Manual and the MAXNC drive software, with linear, circular and helical interpolation, acceleration deceleration, full contouring, 'G' code programming, screen plot, code generation from CAD (CAM), and more.

For more information, phone or write to:

**MAXNC**

6730 West Chicago  
Suites 2 & 3  
Chandler, AZ 85226  
Ph (602) 940-9414  
Fax (602) 940-2384



## CABLE TV BOXES



**(WE'LL BEAT ANY PRICE!)**  
30 DAY TRIAL\* 1YR. WRNTY. \*FREE CATALOG  
QTY. DISCOUNTS \* DEALERS WELCOME!

**1-800-538-2225**

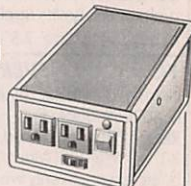
HABLAMOS ESPANOL



<http://www.tvcableboxes.com>  
GLOBAL ELECTRONICS INC.

## NEW INVENTION! BUILD YOUR OWN 5,000 WATT INVERTER

Input 12 vdc  
Output 120 volts AC 60 HZ



You can build this simple but POWERFUL inverter with parts you may already have laying around the house! There is no other inverter built like this inverter. Now anyone can afford a 5,000 watt inverter. Run your entire home!  
PATENT PENDING

1000 watt plans.....\$25.95  
5000 watt plans.....\$40.00

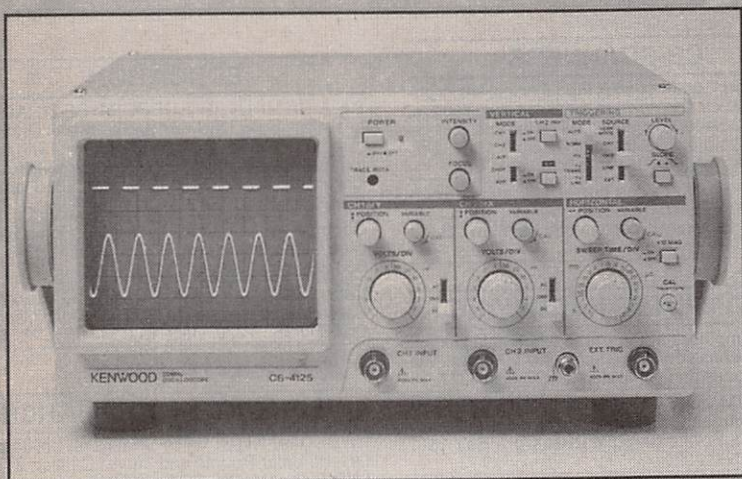
FREE CATALOG

Send order to: CREATIVE SCIENCE  
PO BOX 557 New Albany, IN. 47151



# KENWOOD

*...from the company you've  
been listening to for years...*

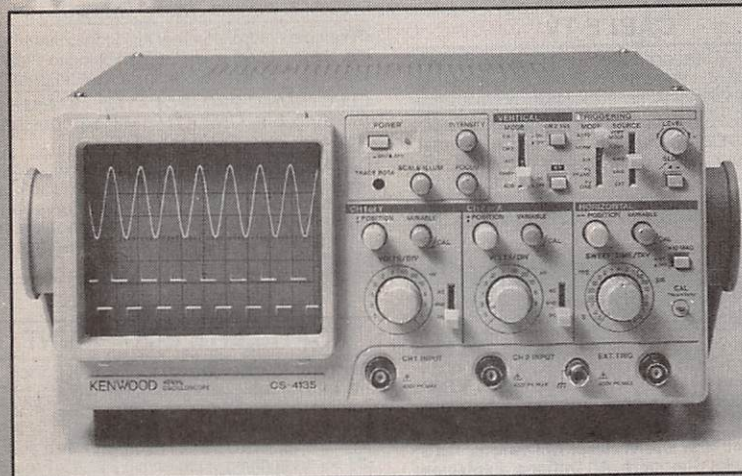


2-Channel, 20-MHz

## CS-4125

Regular \$595

### Sale \$389



2-Channel, 40-MHz Oscilloscope

## CS-4135

Regular \$855

### Sale \$685

***Hybrid IC Technology is the Key to the High  
Quality and High Reliability at Low Cost!***

- **FIX SYNCHRONIZATION** detects the trigger level automatically for the acquisition of stationary waveforms without complicated sync level adjustments.
- **VERT MODE TRIGGERING** enables the acquisition of stationary waveforms for both CH1 and CH2 even when the input signals to the two channels have different frequencies.
- **HIGH WITHSTAND INPUT** voltage of 400V (800Vp-p).
- **RELAY ATTENUATORS** are provided for reliable logic switchover.
- **SCALE ILLUMINATION** (CS-4135 only)
- **DIMENSIONS** (WxHxD): 300(343) x 140(150) x 415(430)mm ( ) including protrusion.  
WEIGHT: approx. 7.2kg (CS-4135) approx. 7kg (CS-4125)



**PRINT**<sup>TM</sup>  
Products International

**Call for your free 84 page test instrument catalog today!!!**  
8931 Brookville Road \* Silver Spring, Maryland \* 20910

\* Phone 800-638-2020 \* Fax 800-545-0058 \* [www.prodintl.com](http://www.prodintl.com)

March 1999, Electronics Now



MONDO • TRONICS

# ROBOT STORE

\* KITS \*

Your

\* BOOKS \*

Mailorder

\* PARTS \*

Source

\* VIDEOS \*

For

\* MODELS \*

Robots!

\* MORE! \*

(REQUEST OUR FREE CATALOG)

www.robotstore.com

800-374-5764

Or write to us:

4286 Redwood Hwy #226-137  
San Rafael CA 94903

Phone 415-491-4600 • Fax 415-491-4696

Email info@mondo.com

# CLASSIFIED

## CB-SCANNERS

**CB Radio Modifications!** Frequencies, kits, high-performance accessories, books, plans, repairs, amps, 10-Meter conversions. The best price since 1976! Catalog \$3.00. **CBCI** Box 1898 EN, Monterey, CA 93942. [www.cbciintl.com](http://www.cbciintl.com)

**CB Trick Books**, three books 1, 2 and 3. Each book \$19.95 each. Repairs, tune ups, and amplifiers. Send money order to **Medicine Man CB PO** Box 37, Clarksville, AR 72830.

## COMPUTER HARDWARE

New computers and parts at wholesale prices, [www.Techass.com](http://www.Techass.com) Toll Free 1-877-Tec-hass. We ship all parts and computers 1-877-832-4277.

**ROBOT** Module. Abundant outputs, inputs, counters, compass, analog. Infinite configuration \$299.00. Free catalog **WINDesign**, Box 138, Boston, NY14025.

## CABLE TV

**Cable TV** descramblers. One-piece units. Scientific Atlanta, Jerrold, Pioneer, and others. Lowest prices around. **Precision Electronics**, Houston, TX anytime. 1-888-691-4610.

**CABLE DESCRAMBLING**, New secret manual. Build your own descramblers for cable and subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2 postage **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

**Wholesale to the public.** The industries leading distributor of cable electronics is now open to the public. We will beat all competitors pricing. Dimension 800-474-2343.

**New!** Jerrold and Pioneer wireless test units \$125 each, also 75DB notch filters \$19.95 each, quantity pricing available please call **KEN ERNY ELECTRONICS** 24-hour order and information hot line 516-389-3536.

**Descramblers, Converters, Activators, Rft's, Ftg's, Bullet Snoopers, All Options Explained, Best Prices, Services, 2yr. Warranty, Free Catalog** 1-800-854-1674 [www.resource-leader.com/aapc](http://www.resource-leader.com/aapc)

**Cube** for Jerrold model CFT 2200, 2014, 2024, 2254 Pioneer 6300-6310 Auto-Multimode, Zenith St-1600 \$175.00 Lowest price call 800-822-8530.

**ALL CABLE TV BOXES. WE'LL BEAT ANY PRICE. 30 DAY TRIAL 1 YEAR WARRANTY. 1-800-538-CABLE (2225).**

**Cable boxes all models, all channels**, lowest prices in the United States. Open seven days a week till midnite, Pacific Time. Call (877) 789-7337 Toll-Free.

**Free Cable Descramblers Plans. For Details Write:** Sierra Publishing, 909 E. Yorba Linda Blvd., Suite H-181, Dept. ENY, Placentia, CA 92870.

**NEW!** Cellphone E.S.N. readers \$250 each, cell phone programmers \$175 each, cell phones \$25 each, DSS satellite dish card readers and programmers \$125 each, credit card readers \$250 each, Cable T.V. notch filters 50 cents each, convertor boxes \$50 each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under \$200 each. You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for only \$59.95 plus \$5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.

## EDUCATION

**Be A COMPUTER SUPPORT SPECIALIST!** Learn computer hardware and software. Great career path. Computers are the future. Free information. Call 1-800-326-9221 or write **Lifetime Career Schools**, Dept: ELN1039, 101 Harrison Street, Archbald, PA 18403.

**Become A Professional Locksmith**, Home Study. Free Career Literature. **P.C.D.I.**, Atlanta, Georgia. 800-362-7070 Dept.LKC342.

**Learn Electronics**. Home Study. Outstanding Careers. Free Literature. **P.C.D.I.**, Atlanta, Georgia. Call 800-362-7070. Dept. ELC342.

## PLANS-KITS-SCHEMATICS

**AWESOME KITS:** Voice Changers, Levitators, Lasers, Solar Robots and more! Catalog \$1.00. **LNS Technologies**, PO Box 67243, Scotts Valley, CA 95067. [www.ccnet.com/~1nstech](http://www.ccnet.com/~1nstech).

**IR remote control Jammer kit.** Stop channel surfing. Send \$12.95 plus \$2.00 Shipping to **PMS PO** Box 88077 Colorado Springs, CO 80908-8077.

**ELECTRONIC PROJECT KITS:** 49 McMichael St., Kingston, ON., K7M 1M8. \$3.00 catalog. [www.qkits.com](http://www.qkits.com). **QUALITY KITS**

**CATALOG:** Broadcasting/micro transmitters, amplifiers, antennas. **Start your own radio station books.** Audio, TV, Ham, CB, Surveillance, Science projects and more. [www.panaxis.com](http://www.panaxis.com) **PAN-COM** Int'l, PO Box 130-3, Paradise, CA 95967

## SATELLITE EQUIPMENT

**Pay TV & Satellite Descrambling 1999 Edition.** All the latest cable and satellite fixes \$16.95. Complete Pay TV series (282 pages) \$59.95. Hacking Satellite Systems Video \$29.95. Scrambling News subscription with web access \$34.95. Everything listed above \$99.95. Free catalog. **Scrambling News**, 4798 South Florida Ave., Lakeland, FL 33813. 941-646-2564. C.O.D.'s are OK. Add \$6.00.

**SKYVISION!** Your Satellite Home Entertainment Source. **Best values:** DBS and C/Ku-band equipment, including 4DTV. Most complete selection: Parts-Tools-Upgrades-Accessories! **Free** Discount Buyer's Guide. Call 800-543-3025. International 218-739-5231. [www.skyvision.com](http://www.skyvision.com).

**DSS Hacking:** How to construct and program smart cards, with pic 16C84, PCB layout, Complete DSS system schematics, \$16.95. Software \$25.00. **CABLETRONICS**, Box 30502R Bethesda, MD 20824.

**Free catalog-satellite TV/GPS-DIY Technical Books**, Installation Videos, Computer Analysis Software [www.baylin.com](http://www.baylin.com) 800-483-2425.

**DSS Test card.** Authorizes all channels for information, plus free bonus. Call toll free 1-888-416-7296.

## BUSINESS OPPORTUNITIES

**Have an idea?** If so, we are a national company working with ideas, inventions, new products. Patent services. Call 1-800-288-IDEA.

**Wholesaler** looking for retailer to carry solar electronics and hobby goods. (916) 486-4373. Please leave message.

**EASY WORK! EXCELLENT PAY!** Assemble boards/products from home. For Free information send SASE: **Home Assembly-EN** Box 216 New Britain, CT 06050-0216.



- ☐ 229 Popular Electronics (1999 back issues) \$5.00  
Write in Issues desired
- ☐ 228 Popular Electronics (1998 back issues) \$5.00  
Write in Issues desired
- ☐ 227 Popular Electronics (1997 back issues) \$5.00  
Write in Issues desired
- ☐ 226 Popular Electronics (1996 back issues) \$5.00  
Write in Issues desired
- ☐ 225 Popular Electronics (1995 back issues) \$5.00  
Write in Issues desired
- ☐ EH96 Experimenters Handbook (1996) \$5.00
- ☐ EH95S Experimenters Handbook  
Summer Edition (1995) \$5.00
- ☐ EH94S Experimenters Handbook  
Summer Edition (1994) \$5.00
- ☐ EH94W Experimenters Handbook  
Winter Edition (1994) \$5.00
- ☐ EH94 Experimenters Handbook (1994) \$5.00
- ☐ EH93 Experimenters Handbook (1993) \$5.00
- ☐ HH95S Hobbyists Handbook  
Spring Edition (1995) \$5.00
- ☐ HH95F Hobbyists Handbook  
Fall Edition (1995) \$5.00
- ☐ HH94S Hobbyists Handbook  
Spring Edition (1994) \$5.00
- ☐ HH94F Hobbyists Handbook  
Fall Edition (1994) \$5.00
- ☐ HH93 Hobbyists Handbook (1993) \$5.00
- ☐ HISTORY Crystal Radio History, Fundamentals  
& Design \$10.95
- ☐ XTAL Crystal Set Handbook \$10.95
- ☐ XTALPRO Crystal Set Projects \$14.95
- ☐ XTALBLD Crystal Set Building \$15.95
- ☐ POP96 POPtronix Hobbyist Handbook (1996) \$5.00
- ☐ POP97 POPtronix Exper Handbook (1997) \$5.00
- ☐ Radiocraft 1993 Projects for Hobbyists \$5.00
- ☐ 219 Electronics Now (1999 back issues) \$5.00  
Write in Issues desired

- ☐ 218 Electronics Now (1998 back issues) \$5.00  
Write in Issues desired
- ☐ 217 Electronics Now (1997 back issues) \$5.00  
Write in Issues desired
- ☐ 216 Electronics Now (1996 back issues) \$5.00  
Write in Issues desired
- ☐ 215 Electronics Now (1995 back issues) \$5.00  
Write in Issues desired

## REPRINTS REPRINTS

- ☐ 174 Electronics Cartoons (The Best of) \$1.99
- ☐ 173 From Not-Working to Networking  
Troubleshooting Local-Area Networks \$2.99
- ☐ 172 33 Bench-Tested Circuits \$1.99
- ☐ 171 36 Time Tested Circuits \$1.99
- ☐ 170 High-Voltage Project for Fun and  
Science Book 1 \$2.99
- ☐ 170A High-Voltage Projects for Fun and  
Science Book 2 \$2.99
- ☐ 169 Think Tank (133 Circuits) \$1.99
- ☐ 169A Think Tank Vol. 2 \$1.99
- ☐ 168 Fact Cards (#34-66) \$1.99
- ☐ 168C Fact Cards (#67-99) \$1.99
- ☐ 168D Fact Cards (#100-132) \$1.99
- ☐ 167 Designing With IC's \$2.99
- ☐ 166 Collected Works of Mohammed Ulyses  
Fips (62 pages, April Fools Collection) \$6.99
- ☐ 165 How to Repair CD Disc Players \$2.99
- ☐ 164 Modern Electrics (April 1908) \$1.99
- ☐ 160 New Ideas - 42 Circuits \$1.99
- ☐ 159 Low Frequency Receiving Techniques  
Building and Using VLF Antennas \$2.99
- ☐ 158 Electro Importing Co. Catalog  
(Circa 1918) \$2.99
- ☐ 157 All About Kits \$1.99
- ☐ 156 How To Make PC Boards \$1.99
- ☐ 154 How To Repair VCR's \$1.99

To order any of the items indicated above, check off the ones you want. Complete the order form below, include your payment, check or money order (DO NOT SEND CASH), payable to and mail to Claggk Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735.

Please allow 4-6 weeks for delivery. No COD's!

To place a credit card by phone, Visa Mastercard or Discover only. You can also order and pay by e-mail. Contact Claggk@gersback.com for details.

**CALL: 516-293-3751.**

**To use your Visa, Mastercard or Discover, complete the following:**

Bill my ☐ Visa ☐ Mastercard ☐ Discover

Card No. \_\_\_\_\_

Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

**MAIL TO: Claggk Inc.**

Reprint Bookstore, P.O. Box 4099, Farmingdale, NY 11735

SHIPPING CHARGES IN USA & CANADA

Up to \$5.00	\$2.00	\$30.01 to 40.00	\$6.00	Overseas Orders must contact
\$5.01 to \$10.00	\$3.00	\$40.01 to 50.00	\$7.00	CLAGGK for shipping charges.
\$10.01 to 20.00	\$4.00	\$50.01 and above	\$8.50	
\$20.01 to 30.00	\$5.00			

Total price of merchandise \$ \_\_\_\_\_

Shipping Charge (see chart) \$ \_\_\_\_\_

Subtotal \$ \_\_\_\_\_

Sales Tax (New York State Residents only) \$ \_\_\_\_\_

Name \_\_\_\_\_ Total Enclosed \$ \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

# CABLE TV EQUIPMENT

Converters, Test Cubes & Chips  
Video Stabilizers

1 Year Warranty  
30 Day Money  
Back  
Guarantee



**"ABSOLUTE LOWEST  
WHOLESALE &  
RETAIL PRICES"  
CABLE U.S.A.  
1-888-388-CUBE**

## SURVEILLANCE

**The Latest High Tech  
Professional Electronic Devices**

Our latest catalog offers a HUGE selection of surveillance, counter-surveillance/privacy devices: **pinhole camera \$129<sup>00</sup>**, hidden video, **"realtime" 12-Hour telephone recorder \$139<sup>00</sup>**, 12 hour VOX recorder phone call register, scanners, bug/phone tap detectors, voice disguisers, locksmithing tools, vehicle tracking, wireless video, and much more. Wholesale/retail.

**We will not be undersold.**

Catalog \$5.00 or  
[www.spyoutlet.com](http://www.spyoutlet.com)

**SPY OUTLET**

PO Box 337, Buffalo NY 14226  
(716) 691-3476/(716) 695-8660

## Cable T.V. Converters & Equipment

Lower  
Prices  
Dealer  
Discounts  
30-Day  
Money back  
1-year  
warranty  
MC, Visa,  
AE, COD



[www.cable4you.com](http://www.cable4you.com)

**1-(800) 888-5585**



## ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
— Abacom Technology .....	81	— James Electronics .....	66
— ABC Electronics .....	82	330 Jensen Tools .....	78
— AES .....	84	— Lynxmotion .....	82
213 Alfa Electronics .....	70	— M <sup>2</sup> L Electronics .....	87
214 All Electronics .....	67	325 Mark V Electronics .....	79
— Allison Technology .....	91	— MAT Electronics .....	5
— Amazon Electronics .....	92	327 MCM Electronics .....	CV3
270 American Eagle Publications .....	81	251 Mendelson Electronics Surplus .....	76
— Andromeda Research .....	86	337 Merrimack Valley Systems .....	84
— Arrow Technologies .....	76	133 MicroCode Engineering .....	CV2
314 Basic Electrical Supply .....	70	— Micro Test .....	87
304 Beige Bag .....	77	— microEngineering Labs .....	66
— Brand Electronics .....	64	— Midwest Laser Products .....	82
322 C&S Sales, Inc. ....	72	— Modern Electronics .....	66
— Cable USA .....	99	— Mondo-tronics Inc. ....	98
— Circuit Specialists .....	88	318 Mouser Electronics .....	66
— CLAGGK, Inc. ....	14, 62	— MSC Electronics .....	93
— Clearview Group .....	88	— NRI Schools .....	19
— Cleveland Inst. of Electronics .....	37	— Netcom .....	75
— Command Productions .....	64	334 OWI .....	96
— Computer Monitor Maintenance .....	90	262 Parts Express Inc. ....	69
224 Consumertronics .....	68	— PC Boards .....	64
228 Cool Amp Conducto Lube .....	75	— Pioneer Hill Software .....	86
— Crazy Liz's .....	76	222 Polaris Industries .....	63
— Cylab .....	93	315 Prairie Digital .....	91
234 Dalbani Electronics .....	74	264 Print (Pace) .....	97
235 Danbar Sales .....	68	266 Ramsey Electronics .....	65
— EDE - Spy Outlet .....	99	283 Resources Unlimited .....	95
— Electronic Technology Today .....	6	— Science Fair Electronics .....	92
— Emac Inc. ....	76	— Securetek .....	93
— Fair Radio Sales .....	82	— Sil Walker .....	66
335 Foley-Belsaw .....	83	— Square 1 Electronics .....	76
— General Device Instruments .....	86	— Tech-Specialties .....	92
160 Global Specialties .....	9	— Techniks .....	93
— Grantham Col. of Engineering .....	4	— Technological Arts .....	92
329 Graymark International .....	77	311 Telulex .....	81
— Great Southern Security .....	94	333 Test Equipment Depot .....	79
— Home Automation .....	86	217 Test Equipment Sales .....	80
331 Howard Electronics .....	89	275 Timeline .....	87
— Howard Electronics .....	90	— U.S. Cyberlab .....	85
— IEC .....	91	282 Velleman .....	71
— Information Unlimited .....	78	— Video Media .....	93
— Intec Automation .....	93	310 Visitect Inc. ....	80
138 Interactive Image Technologies .....	CV4	— Weeder Technologies .....	93
— Intronics, Inc. ....	84	132 Windjammer Barefoot Cruises .....	4
319 IVEX Design .....	85	— World Star Technologies .....	92
— J&M Microtek, Inc. ....	92	— Worldwyde .....	92

## ADVERTISING SALES OFFICES

**Gernsback Publications, Inc.**  
500 Bi-County Blvd.  
Farmingdale, NY 11735-3931  
Tel. 516-293-3000  
Fax: 516-293-3115

**Larry Steckler**  
Publisher (ext. 201)  
e-mail: advertising@gernsback.com

**Adria Coren**  
Vice-President (ext. 208)

**Ken Coren**  
Vice-President (ext. 267)

**Christina Estrada**  
Assistant to the Publisher (ext. 209)

**Marie Falcon**  
Advertising Director (ext. 206)

**Adria Coren**  
Credit Manager (ext. 208)

### For Advertising ONLY

#### EAST/SOUTHEAST

**Megan Mitchell**  
9072 Lawton Pine Avenue  
Las Vegas, NV 89129-7044  
Tel. 702-240-0184  
Fax: 702-838-6924  
email: mmitchell@gernsback.com

#### MIDWEST/Texas/Arkansas/Okla.

**Ralph Bergen**  
One Northfield Plaza, Suite 300  
Northfield, IL 60093-1214  
Tel. 847-559-0555  
Fax: 847-559-0562  
email: bergenrj@aol.com

#### PACIFIC COAST

**Anita Bartman**  
Hutch Looney & Associates, Inc.  
6310 San Vicente Blvd., Suite 360  
Los Angeles, CA 90048-5426  
Tel. 323-931-3444 (ext. 227)  
Fax: 323-931-7309  
email: anita@hlooney.com

#### Electronic Shopper

**Joe Shere**  
National Representative  
P.O. Box 169  
Idyllwild, CA 92549-0169  
Tel. 909-659-9743  
Fax: 909-659-2469  
email: joe@greencafe.com

#### Megan Mitchell

National Representative  
9072 Lawton Pine Avenue  
Las Vegas, NV 89129-7044  
Tel. 702-240-0184  
Fax: 702-838-6924  
email: mmitchell@gernsback.com

#### Customer Service

1-800-999-7139  
7:00 AM - 6:00 PM M-F MST







**To Order a New Subscription or  
To Renew an Existing Subscription  
Call 1-800-999-7139**

.20¢ POSTAGE  
REQUIRED IN  
U.S.A.

**Electronics  
NOW®**

READER SERVICE MANAGEMENT DEPT.  
P.O. BOX 5192  
PITTSFIELD, MA 01203-9989

.20¢ POSTAGE  
REQUIRED IN  
U.S.A.

**Electronics  
NOW®**

READER SERVICE MANAGEMENT DEPT.  
P.O. BOX 5192  
PITTSFIELD, MA 01203-9989



# MCM ELECTRONICS®

## The Source For All Of Your Electronics Needs

When ordering, please provide this code: **SOURCE CODE: ENS56**

Prices Effective Feb. 4 through March 19, 1999

For over 20 years, MCM has been the leading supplier to the electronics service industry. Huge inventory, rapid delivery and competitive prices have made MCM the choice for:

- Hobbyists
- Service Technicians
- Educators
- Installers

Discover the MCM difference, call today for your free catalog.

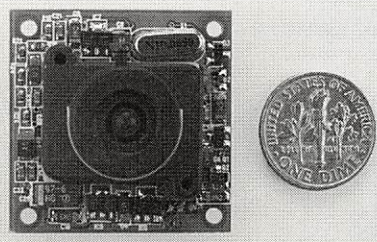
As Low As  
**\$2.99**

Order #29-2615  
Order #29-2620

### Nickel-Metal Hydride Cells

Get NIMH performance in a standard "AA" or "AAA" cell. Performance is 50% over that of Ni-Cad batteries of the same size. Sold individually.

Order #	Size	(1-9)	(10-49)	(50-up)
29-2615	"AAA"	\$3.59	\$3.29	\$2.99
29-2620	"AA"	4.19	3.89	3.59



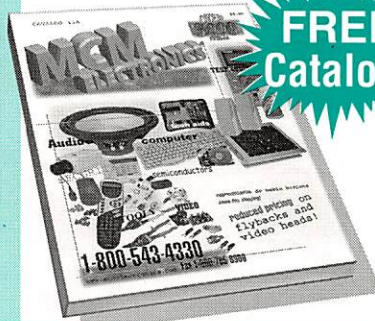
Order #82-2990

**ONLY \$49.00**

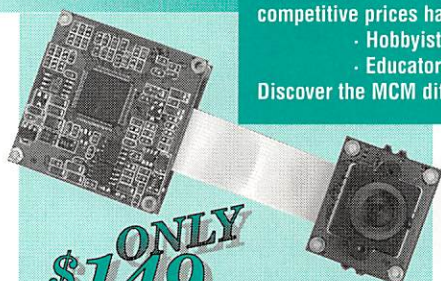
### DEFENDER SECURITY

#### Micro PC Board Camera

B/W CCD camera measures only 1 1/4" x 1 1/4" x 1". Provides NTSC composite video output. Built-in 3.6mm lens provides viewing angle of 92°. Requires 12VDC, 300mA. (#58-3330 AC adaptor). **Regular price \$64.95**



**FREE Catalog!**



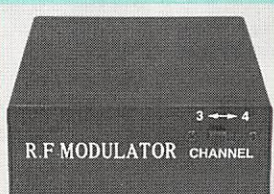
**ONLY \$149**

Order #82-3015

### DEFENDER SECURITY

#### Color PC Board Camera

Ideal for any observation, multimedia or security application. Provides NTSC composite video output. Features automatic white balance, 330 lines of horizontal resolution and AGC. Requires 12VDC, 240mA. **Regular price \$199.00.**



Order #33-1480

**ONLY \$10.95**

### RF Modulator

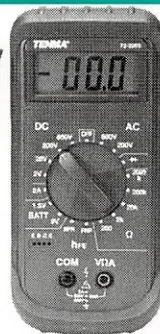
Outstanding price on this popular audio/video/surveillance accessory. Accepts standard A/V signal and places it on channel three or four. RCA type inputs, "F" type output. Requires 117VAC. **Regular price \$19.95.**

**ONLY \$49.95**

Order #21-147

### TENMA Solder Station

Perfect for most soldering applications including SMD. Overheat protection with closed loop temperature control provides precise heat. Includes replaceable iron clad conical 3/64" tip. Linear LED display shows operating temperature. **Regular price \$79.95.**



**ONLY \$24.50**

Order #72-2055

### TENMA®

#### Portable DMM

Affordable hand held meter features 3 1/2 digit LCD display, DC voltage measurement to 600V, transistor and battery test. Input impedance 10Mohm. Includes holster and test leads.

**Regular price \$31.95**



Order #21-935

**ONLY \$39.95**

### Fluorescent Magnifier Lamp

5" lens has 3x magnifying power, ideal for any workbench. Spring balanced arm reaches 45". Includes 22W fluorescent tube. Beige finish. **Regular price \$49.95**



**ONLY \$7.50**

Order #35-445

### Hi-Fi Stereo Headphones

Professional-quality headphones feature 40mm super thin diaphragm drive units. Frequency response: 20Hz~20KHz. 9' straight cord has gold plated 3.5mm plug with 1/4" adaptor. **Suggested list: \$12.95**

**1-800-543-4330**

[www.mcmelectronics.com](http://www.mcmelectronics.com)

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.

**Same Day Shipping!**

In stock orders received by 5:00 p.m. (YOUR TIME), are shipped the same day.



**MCM ELECTRONICS®**

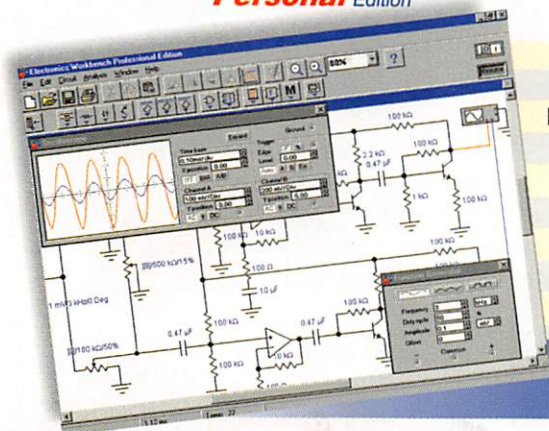
650 CONGRESS PARK DR.  
CENTERVILLE, OH 45459  
A PREMIER FARNELL Company

**SOURCE CODE: ENS56**



THE WORLD'S MOST POPULAR  
DESIGN TOOL CHOSEN BY OVER  
**100,000 USERS!**

## Electronics Workbench® Personal Edition



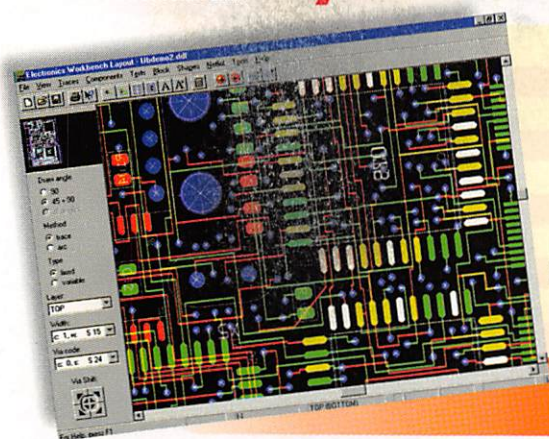
TRUE MIXED ANALOG/DIGITAL  
FULLY INTERACTIVE SIMULATION  
PRO SCHEMATIC EDITOR  
6 VIRTUAL INSTRUMENTS  
ON-SCREEN GRAPHS  
OVER 4,000 MODELS  
8 POWERFUL ANALYSES  
FREE TECHNICAL SUPPORT

**\$299**

### Full-featured schematic capture and SPICE circuit simulation!

The world's most popular circuit design tool that sets the standard for powerful, insightful SPICE simulation. Create professional looking schematics and then with the flick of a switch, display simulated waveforms live on a suite of virtual instruments. Includes 15 powerful analyses and a library of over 4,000 robust component models.

## Electronics Workbench® Layout Personal Edition



AUTOROUTING  
REROUTE WHILE MOVE  
32 ROUTING LAYERS  
50" X 50" BOARD SIZE  
OVER 3,500 LIBRARY SHAPES  
EXTENSIVE OUTPUT  
REAL TIME DESIGN RULE CHECK  
DENSITY HISTOGRAMS  
FREE TECHNICAL SUPPORT

**\$299**

### Power-packed PCB layout with autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, EWB Layout is the best way to quickly produce well-designed boards.

**BUY BOTH AND SAVE! ~~\$598~~ \$548**

CALL FOR INFORMATION  
AND PRICING ON OUR  
PROFESSIONAL EDITION.

**800.263.5552**

**30-DAY MONEY-BACK GUARANTEE**

Fax: 416-977-1818

E-mail: [ewb@interactiv.com](mailto:ewb@interactiv.com)



For a free demo, visit our website at [www.electronicworkbench.com](http://www.electronicworkbench.com)